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CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—
Briefly Told..... 37
Gas Stocks as Investments—An Old-New Firm—Annual Meeting, Lebanon, Pa.—Hints from Poughkeepsie, N.Y.—Will the Brush Company Carry out the Cincinnati Contract?—Annual Meeting, Fresno, Cal.—And Other Notes.
Experiments on the Relation of Electric Lamps to Combustible Bodies..... 38
The Market for Gas Securities..... 38
The Chemistry of Illuminating Gas..... 39
*Carburetor for Gas Engines..... 40
*The Foulis Regenerative Furnace..... 41
The Deterioration of Electrical Conductors..... 41
*The Kusnezov Gas Washer..... 42
The Incandescent Light Controversy..... 42
Coke and Charcoal Compared..... 43
Chimney Proportion..... 44
Petroleum Market for 1889..... 44
ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 45
A Gas Inspector for Cleveland, O.—Free Turkeys—Consolidated at Fremont, O.—Public Lighting, Boston, Mass.—The Striking Stokers—Has the Council the Right to Regulate Gas Rates at Kansas City?—Gas Lamp Posts and Mail Boxes—Public Lighting, Denver, Col.—The Coroner's Verdict, Asheville (N. C.) Explosion—Public Lighting, Canton and Cleveland, O.—Gas Stock at Auction—Public Lighting, East St. Louis, Mo.—Hints from Davenport, Ia.—Pleased with their Gas Engine—Annual Report, Supt. Public Lamps, Springfield, Mass.—And Many Other Items.

[OFFICIAL NOTICE.]

New England Association of Gas Engineers.

SECRETARY'S OFFICE, BIRMINGHAM, CONN., Jan. 10, 1890.

The Twentieth Annual Meeting of the New England Association of Gas Engineers will be held at Young's Hotel, Boston, on Wednesday and Thursday, Feb. 19th and 20th. The meeting will be called to order on Wednesday, at 10 A.M., by the President, Mr. R. B. Taber.

At the present moment it is impossible to give a list of the papers which will be read at the meeting, but it is hoped that the literary part of the programme will equal any of those held in past years.

Persons eligible for membership who desire to join the Association will please communicate with the Secretary, who will forward at once blank form of application. CHARLES H. NETTLETON, Sec'y.

BRIEFLY TOLD.

GAS STOCKS AS INVESTMENTS.—Following up our remarks of a week ago on the satisfactory increase in the gas business as shown from the records of the last twelvemonth, it is our present purpose to offer something further in confirmation of the fact that gas proprietors and gas makers share equally in the comfortable assurance that not only is their joint dependence holding its own against all comers, but is again outstripping them, as in the days of about a decade ago. In the course of the past year we have collated from various reliable sources the opening and closing prices of gas shares at 87 different points in the country; and we think the result of the teaching disclosed by the figures is most convincing as to the upward tendency of this class of securities. The figures were obtained from places representative of all grades in respect to varying magnitude. That is, the Consolidated Company of this city, with its $35,430,000 of capital, shares in the average with a small company in Illinois with a capital of less than $20,000. The total capital figuring in the average is 62 millions of dollars. Of the 87 places noted a decrease in the value of the shares is found to have occurred in 5 instances—the average shrinkage being represented by 12½ points—while an increase, ranging from 2½ points to 35 points, is the result at the remaining localities about which inquiry was made. Spreading the averages over the entire value of the 62 millions, we find that the net average gain for the year (all these deductions are based on the market changes, on the "high and low" quotations for the year) was 11¼ per cent., representing an increase in value for the twelvemonth of the snug sum of $7,285,000. The average rate of dividend of these companies—excluding the Consolidated Company of this city, but admitting in the average 3 companies that did not pay any dividend—is shown to be 7.75 per cent. The dividend paid by the Consolidated Company for the year was 5 per cent., as against the 4 per cent. return made by it in 1888. The returns received go to show that Massachusetts gas shares are those which increase in value in the greatest relative proportion, and we may be forgiven for hinting that the method of State protection there followed is in no small degree responsible for the confidence manifested by investors. We would like to have it in our power to place before our readers these statistics in unmasked form, but as it was with our inquiries for sendout figures, so also was it with the request for the market valuation of shares—"the facts are so and so, but do not handle them so that our identity may be revealed." In any event, the figures, even though somewhat obscured, are nevertheless of a sort well calculated to dissipate any cloudy idea that gas shares do not continue to find favor with investors who value safety and progress as factors to determine them in the interest-earning disposition of their funds.

AN OLD-NEW FIRM.—It is probably no very great secret by this time that the Smith & Sayre Manufacturing Company has ceased to be, and that gas men are called to welcome its successor in the shape of the Isbell-Porter Company. Of course, the implied change is in reality no change at all, for both Messrs. Porter and Isbell have been the Smith & Sayre Company for years, and it is quite a certainty that they shall continue so for years to come. No change whatever is to be or has been made in the business of the firm, whose headquarters, as before, are to be at 245 Broadway, this city. We might, however, modify our statement in respect to the "no change whatever" clause by adding the qualifier that important changes are to be made on the Newark (N. J.) factories of the firm, which are to be greatly enlarged. This action had to be taken to enable the Company to keep easy pace between the reception and completion of contracts. The Company reports that the business outlook for 1890 is of the brightest sort.

THE METER COMPANY ANNUALS.—We are in receipt of copies of the annuals published by the Messrs. Helme & McIlhenny, of Philadelphia, the American Meter Company, and D. McDonald & Company, of Albany. We thought (and so said) last year that the meter men had about reached perfection in the arrangement and printing of their annuals, but that we were in error is easily discovered by a glance at the editions for this year. The lighting tables are as usual a feature of the books, and the supplementary pages are charts of information at once valuable and prettily arranged. The American Company's designer has brought out something novel in the way of a cover this year. The Helme & McIlhenny volume is notable for the fact that apart from its convenient pocket shape, it contains but 6½ sheets devoted to advertising—this feature is not very prominent in any of the annuals now before us—and the McDonald specimen is notable particularly for the nice discrimination shown in editing the technical matter with which its pages abound. In their entirety the annuals are models of neatness, and there is little doubt that they will be eagerly sought for. Another thing in connection with the current editions that cannot help to attract the attention of the "old-timer" is the great disparity in their appearance when compared with the original volumes of some years ago. Of course, the difference is all in favor of the annual of to-day.

THE Parker-Russell Mining and Manufacturing Company, of St Louis, Mo., has been again awarded the annual contract for repairs and renewals to benchwork in both plants of the Cincinnati Gas Light and Coke Company.

ANNUAL MEETING, LEBANON, PA.—At the annual meeting of the Lebanon (Pa.) Gas Company (two-thirds of the stock being voted on) the following officers were chosen: President, Col. T. T. Worth; Secretary and Treasurer, John W. Mish; Managers, Messrs Anthony Aurentz, C. H. Killinger, Chas. H. Meily, J. W. Mish, Geo. H. Reinohel, Grant Wiedman and Col. T.T. Worth. The regular semi-annual dividend of 4 per cent. was declared, but the Managers failed to order a reduction in the gas rate, which it was presumed had been fully provided for. The average rate obtained for gas in Lebanon is $2.35 per 1,000 cubic feet, but it is quite likely, however, that a considerable concession will be made in the year. Large plant extensions were completed last year, these including a holder of 30,000 cubic feet capacity, the iron work for which was furnished by Messrs. Deily & Fowler, and the excavation and tank work by Mr. W. C. Whyte, of New York. Both contractors finished their tasks in their usual manner. An interesting thing in connection with the executive management of this Company is afforded in the case of Secretary and Treasurer Mish, who has acted in that capacity since 1856, the year in which the Company was incorporated. Of the 15 persons named in the original papers of incorporation but five are living, and only two of these are at present holders of the stock.

THE Poughkeepsie (N. Y.) Gas Company will this spring put up an auxiliary holder on the site of the Laurel street plant. As an evidence that cheap gas for cooking, heating and power purposes pays (the Poughkeepsie rate for these purposes is $1 per 1,000) we may note that the Company now has in position 200 cooking and heating stoves, and the average monthly consumption chargeable to this use is rather over than under 250,000 cubic feet.

IT seems that the Brush Electric Light Company, of Cincinnati, O., is in the position of the youth who filled his mouth without paying due heed to the capacity of the same. In its eagerness to secure the contract for the public lighting it bid the remarkable rate of $59.98 per lamp per annum, the schedule calling for all-night lighting and 2,000-candle power. We think the Company is hesitating in the breach, simply because at the figures noted it must lose money on every lamp that it would maintain. It is said that the "Parent Company," which it is presumed in this case is the Thomson-Houston Company, of Boston, objects to completing the contract for the simple reason that there "is no money in it." In any event, the Company is not taking any steps to get ready for the work.

AT the annual meeting of the Fresno (Cal.) Gas and Electric Light Company, the following result was reached: President, Lewis Leach; Vice-President, F. G. Berry; Secretary, F. C. White; Superintendent, Daryille Decker; Assistant Superintendent, S. E. Johnson; Directors, Lewis Leach, F. G. Berry, P. P. Dryler, W.W. Phillips and C. M. Berry. Important betterments will be made at Fresno this season.

WE understand that the formation of a Gas Company for Aurora, Neb., is being seriously considered. Aurora is the capital seat of Hamilton county, and is growing rapidly in population and wealth.

THE recent rise in Baltimore Consolidated gas shares is attributed by some to the likelihood that the City Council will pass an ordinance based on the lines of the proposition recently submitted by Mr. Armstrong, whose argument and suggestions will be found in the JOURNAL for December 23, 1889. Perhaps this likelihood may have had some effect in the direction indicated; but the "guessers" should not lose sight of two other factors that would cause a similar result—the greatly increased business of the Company, which now more than ever feels the impulse of good management in all its departments.

THE Supreme Court of the State of Illinois has decided that an accepted franchise constitutes a contract. This finding was made in the case of the Chicago Municipal Gas Light and Fuel Company vs. the Town of Lake, and the salient points of decision are: The revised statutes of Illinois, c. 32, section 5, which authorizes corporations to exercise all powers necessary to carry into effect the objects for which they are formed, does not empower a gas company, incorporated for the purpose of supplying gas to towns, to lay pipes in the streets of a town whose charter gives the town authorities power to control and regulate its streets, without the consent of the town. A town ordinance authorizing a gas company, on condition of its furnishing gas at specified rates, to lay pipes in the streets, is, after it has been accepted by the gas company, a contract and not a revocable license.

WE understand that Mr. Frederic Egner has been appointed Engineer-in-Chief of the Laclede Gas Company, which means that he is to have charge of the works' end of the gas supply of the city of St. Louis. A superintendent is to be named for each station division of the plant. While not in position to say that the appointment has been officially made, nevertheless our information comes from a source so unlikely to be misinformed that we will venture to extend to him our congratulations on his promotion.

Experiments on the Relation of Electric Lamps to Combustible Bodies.

The Paris Society of Electricians have carried out a series of experiments as to the danger of fire from electric lighting. An experiment was made with a bare wire, placed on a small board, and in part with a second board—a wire which should normally conduct a current of about four amperes—and the current was carried up to 40 amperes without the wood commencing to carbonize. For a current much more intense the wood took fire at the part where the wire is uncovered before burning the other part, where the want of air made inflammation slower. It is known that these accidents are avoided in a very efficacious manner in practice by the use of fusible plugs. In order to determine to what extent the lamps themselves were capable of setting fire to strips and combustible bodies placed in their vicinity, the globe of an ordinary arc lamp of the Canse system was enveloped in several thicknesses of green tarletan; a 32 candle incandescent lamp was enveloped in the same way, the folds of the material being joined under the lamp by an india rubber band; a lamp of 33 candles was covered with a cotton cap of double thickness; another was covered with a calotte of black silk, which was in its turn covered with another of black velvet; two lamps were covered with two layers of gummed wadding, white in one case and black in the other; a lamp of 32 candles was placed in vertical fold formed by an old theatrical decoration; and lastly, a lamp of 300 candles was applied against an old decoration. It was found that neither carbonization nor exaggerated heating took place in 20 minutes in the first, second, fifth or seventh experiment; at the end of a minute and a half the material in the eighth case carbonized at contact with the glass and began to burn without flame; at the end of two minutes, after melting and carbonization of the layers of wadding, the lamps in experiment sixth burst in, setting fire to the envelope; in about six minutes the velvet calotte was carbonized and began to burn slowly; at the end of ten minutes the cotton cap was partly carbonized at the points of contact, but combustion had not been commenced.

The Market for Gas Securities.

The market for city gas shares was buoyant during the week, and the investment demand was a feature of the purchasing. No doubt the December and January interest and dividends are finding their way into permanent investments. Consolidated sold to-day (Friday, noon) at 95¼, and it is worthy of note that this is the highest figure touched since 1887. Other city shares also joined in the upward movement. All classes of Brooklyn stocks are strong and higher. Chicago Trusts are steady at 44¾ to 44¾; and Baltimore Consolidated is up to 49¾ to 50. The Poughkeepsie (N. Y.) Company has increased its capital stock from $84,000 to $100,000. The shares of this Company are freely bid for at 120, with no offerings.

The Chemistry of Illuminating Gas.

Article XXXV., in the well-written series on this subject, as contributed by Mr. Norton H. Humphrys to the London *Journal*, is as follows:

An important paper on the manufacture of illuminating gas from paraffine oil was read before the Royal Scottish Society of Arts, by Dr. Stevenson Macadam, in 1882. He stated that for several years past his attention had been repeatedly drawn to the subject of the production of gas of a permanent quality from these oils. At the commencement, the experiments were not very satisfactory, owing to the varying quality of the oil; but later on, by working with special kinds of oil which had to some extent undergone purification, and by paying attention to the question of the temperatures at which these oils were subjected to destructive distillation, he obtained reliable results. He had employed the crude oil which first came over in the distillation of shale for the purpose of making permanent gas, and had also taken it as a sort of standard as to the quality of the gas obtained from the other oils. If the crude oil was distilled and the volatile spirit removed from the distillate, green oil was obtained; and this, when rectified by the employment of acids and alkalies, so as to remove the tar bases, and treated for burning oil, intermediate oil, and solid paraffine, yielded a residue known as blue oil. An extremely volatile spirit known as gasoline was extracted from the first distillate of crude oil; but it was so combustible and explosive as to be unsuitable for the preparation of gas. An oil suitable for gas making should be thin enough to run readily into the retort at ordinary temperatures; and regard should be had to the specific gravity, and to the flashing and firing points. As to the method of working, he kept the retort at a cherry red heat, for which purpose some little skill was necessary, just as with a coal gas retort. The oil was supplied to the retort from a suitable reservoir through a long syphon tube, so as to prevent the gas being driven back, and the supply of oil could be easily regulated. Working in this manner no difficulty arose. The retorts kept wonderfully clean, and after working one for a whole day there would only be a little deposit of soot. He obtained the following practical results:

	Crude oil.	Green oil.	Blue oil.
Cubic feet of gas per gallon,	98.7	102.5	127.4
" " " ton....	26,026	25,977	32,492
Candle power of 5 cu. ft....	50.4	53.2	54.3

About 80 per cent. of the quantity of light that would be obtained by burning the oil in lamps of the best construction was represented by these quantities of gas; and the cost of a ton of crude oil was £4 18s. 10d., or something less than 4s. per 1,000 cubic feet of 50-candle gas. The crude oil has the disadvantage of a low flashing point—92° Fahr. The green oil, having had the more volatile constituents extracted, was better. It flashed at 165° Fahr., and fired at 193° Fahr. It could be obtained for 7d. per gallon, or £7 9s. per ton. The blue oil was heavy, but fluid at ordinary temperatures, and, of course, more expensive. Dr. Macadam had also worked with a number of other oils, but had not obtained satisfactory results either in regard to quality or quantity. The heavier oils obtained by the destructive distillation of coal were included in this category. The best result obtained from them was 95 cubic feet of 42 candle gas per gallon, or 25,000 cubic feet per ton. The manufacture of oil gas was much simpler than that of coal gas. No scrubbers or purifiers were needed. The gas was simply passed through the condensers, where a little tar separated, and then it was conveyed to the gasholders, and was quite permanent.

In a communication to the *Journal*, a year or two later, Mr. Ivison Macadam mentions the important fact that gas made from "crude oil as obtained from shale, or semi-refined varieties, such as the so-called "blue or green oil," is much contaminated with sulphur and ammonia compounds, and with carbonic anhydride. It may here be remarked that there is considerable divergence on this point. As just noticed, Dr. Stevenson Macadam infers that the oil gas needs no purification. As a matter of fact it is usual to subject oil gas, in practice, to the action of a scrubber and a lime purifier, even when secondary products are used; so we may safely infer that this would be indispensable in the case of crude oil or crude petroleum. If the gas is to be used for buoys, railway trains, etc., the impurities may remain; but he considers it necessary that they should be removed if the gas is to be distributed in the ordinary way. He therefore suggests the employment of purer oils as a means of avoiding the expense of purification. He then describes the apparatus patented by Mr. Paterson, which simply consists of a number of tubes carried through the lid of an ordinary horizontal retort, nearly to the back end. The fluid is fed into these tubes and is vaporized as it passes along them. The vapor in the course of its return journey from the back to the front of the retort, is converted into permanent gas. The conversion is not complete, as a quantity of oil is deposited in the condensers, and it is so far charged with soot that it cannot be used again. But the results are very satisfactory; 100 cubic feet of 60-candle gas being readily obtained from ordinary burning oil. In this gas there are about 36 per cent. of olefines condensible by bromine; and the carbonic anhydride does not exceed 1.4 per cent. The proportion of this impurity would, however, depend upon the quality of the oil used. Reckoning the oil at 6d. per gallon, and the manufacturing charges at 1s., the cost of 1,000 cubic feet of oil gas would be 6s. But in comparing this with ordinary coal gas the quality must be considered. Bulk for bulk, the oil gas would be dearer; but when the 60-candle oil gas is compared with 16 or 20-candle coal gas it is much cheaper, light for light.

At a later period this gentleman read a paper before the Glasgow and Scottish Section of the Society of Chemical Industry, comprising a description of practical tests conducted upon several kinds of oil obtained in the Scottish shale industry, and one test of ordinary American petroleum. The results obtained are considerably higher than those already indicated, which may be due to improved apparatus, and also to the use of a burner suited to the consumption of these high quality gases at the photometer. In the course of the discussion which followed the reading of the paper, Dr. Wallace asked if the author had tried ordinary crude oil from blast furnace tar. A trial of this substance made by himself did not afford very promising results. It gave a large proportion of tar in the condenser, about one-third of the whole, and exhibited a tendency to choke up the pipes and to deposit carbon in the retorts. This oil was very cheap, and if it could be conveniently applied, it might well be used in conjunction with common coal as a means of producing gas equal to cannel gas—say, 22 to 26-candle power.

This subject was daily increasing in importance, because the cannel coal fields, particularly those of the better class, were being rapidly worked out, and some gas suppliers had even thought of reducing the quality of their gas, in view of the difficulties that might be experienced in the obtaining of supplies of first-class or even second-class coal. Mr. W. Foulis criticised the Paterson apparatus. He thought the small tubes would be likely to get choked, and that, being fixtures, they would interfere with the removal from the retort of the carbon that would undoubtedly accumulate. He also suggested the use of a jet of steam in conjunction with the oil. A simple apparatus on this principle was used in America in ordinary retorts, and, being attached to the lids, it could be taken away or brought into use, as might be desired, in a few minutes. It consisted of a tube attached to the mouthpiece and extending nearly to the back of the retort. Inside it was an inner tube, into which the oil was blown by a jet of steam. Escaping from this, the vapor and steam passed down the outer tube to the back of the retort, and were converted into permanent gas in coming forward to the ascension pipe. Professor Mills asked how long the retort would run without cleaning, and also as to the quantity of fuel required to maintain the high temperature at which it was worked. Mr. Macadam said he had not obtained satisfactory results, or figures of any practical value, with blast furnace tar; and he did not think the Paterson apparatus would give good results with such oils. The rectified coal oil used in his experiments was obtained from ordinary coke ovens. Though the tubes in the retort might at first sight appear an objection to a practical man, he had worked with them for some months without choking; and the apparatus had been in the hands of ordinary workmen, in no way specially skilled. The tubes were attached to the door of the retort, and could be removed with it; so they could scarcely be regarded as fixtures. It was seldom that cleaning was required, but when necessary it could very easily be done. He had made some experiments with the use of a jet of steam, and would bring forward his results on some future occasion. The gas had been rigorously experimented upon in regard to permanency, and proved to be quite as permanent as the coal gas supplied in Edinburgh. Although the tar contained a large proportion of naphthaline, it must be remembered that the proportion of tar was small; and he could not say if there was much naphthaline in the gas. He could not at the moment give the cost of the gas.

The preceding, together with some other matter relative to the subject of gas making from oil, invoked an editorial article in the *Journal* presenting other phases of the matter which should not be passed unnoticed. While admitting that experiments of this kind are deserving of every encouragement, as it is impossible to learn too much about the gas-making properties of mineral oils, especially as throwing a side light on some of the obscurities of coal gas manufacture and purification, it was submitted that there is a wide chasm to be bridged before the system of oil gas making can be worked in practice on a large scale. Professor Macadam's results were obtained from iron retorts worked at moderate heats; and there seemed to be a general idea that these liquid hydrocarbons needed only a moderate heat to gasify them, and

further, that this heat should be applied by degrees, so as first to convert the oil into vapor, and then to "fix" the vapor as a permanent gas. The experience of gas engineers who had had occasion to carbonize oil in ordinary gas works did not agree with this, as they found that the hottest clay retorts were best for the purpose. The residual deposit of carbon was the *crux* of oil gas making. Professor Macadam admitted that at least three-eighths of the burning oil remained in forms other than gas; and it might be assumed that carbon accounted for a considerable portion of the loss. The carbon deposit troubled the early American carbonizers of oil, and finally convinced them that they were working on the wrong principle. As soon as the oil met the heated surface, the more volatile portion passed off as vapor. The "fixing" of this vapor was attended with some formation of carbon, which was deposited in the retort. The liquid that remained was found to be heavier, richer in carbon, more difficult to gasify, and left a considerable deposit of carbon. So the result was a rapid accumulation of carbon, especially where the liquid entered the retort, but also upon all parts of the heated surface. In the iron retort comparatively little deposit would be formed at first, but as it deposited it would form a coating on the interior surface of the retort, like boiler scale, which would reduce the temperature to which the fluid was exposed. After a time the foul retort would not give more than half as much gas as was obtained at the commencement.

Many attempts had been made to get over this deposit of carbon—such as filling the retort with thin sheet or scrap iron; but the fact remains as one of the gravest evidences against mineral oil gas, that the direct carbonization of oil from gas has been abandoned in the United States after repeated trials. These attempts had discovered that the two principles that the oil must be gasified at the highest possible temperature, and that contact of the fluid with the interior surface of the retort should be avoided as far as possible. This might be accomplished by injecting the charge in a spray sufficiently fine to be gasified by radiant heat before it could touch the sides.

Carburetor for Gas Engines.

U. S. Letters Patent (No. 415,978) were granted on Nov. 26, 1889, to D. S. Reagan, of San Francisco, Cal., for an improved carburetor for gas engines. In describing the same Mr. Regan explains that the details of construction will be readily understood by an examination of the drawings, in which Fig. 1 is a vertical section taken through *a a* of Fig. 3; Fig. 2 is a perspective view of the exterior of the carburetor; Fig. 3 is a horizontal section taken through *d d* of Fig. 1; and Fig. 4 is a view showing the connection of the carburetor with the engine.

Fig. 1

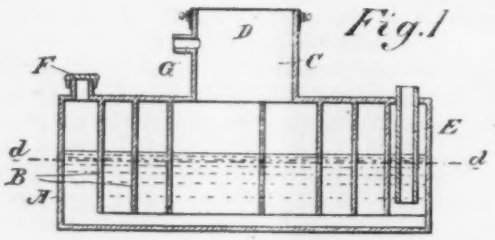
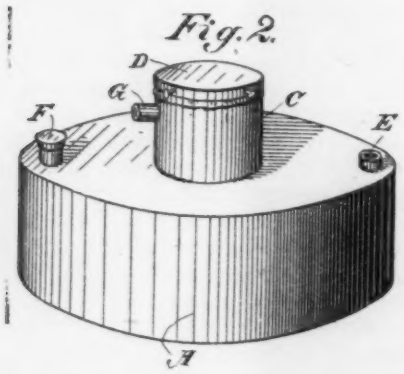


Fig. 2



The object of the invention is to provide a device for charging atmospheric air with the vapor of a light hydrocarbon liquid, and transmitting this vapor directly to the engine cylinder, within which it is ignited and exploded, so as to propel the piston of the cylinder, said piston acting as a pump during alternate strokes, by which a sufficient quantity of air is drawn into the vacuum produced by the movement of the engine piston to form a single charge for the engine, the carburetor ceasing to act immediately upon the stopping of the engine.

A is the exterior casing of the carburetor, having an extension or chamber *C* in the center of its upper portion. The top of this chamber *C* is covered by a flexible diaphragm *D*, which may be made of any suitable flexible material—as leather or parchment—and which serves by its flexibility to relieve the apparatus from the sudden vacuum which would otherwise be caused by the stroke of the engine piston.

G is a pipe extending from the chamber *C* to the engine cylinder *H*, and through which the carbureted air passes to the engine, being drawn

Fig. 3

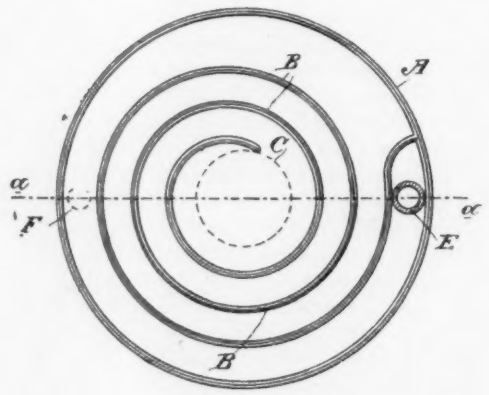
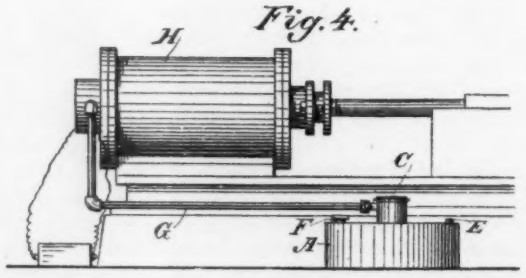


Fig. 4



in at *E* by the vacuum caused by the forward movement of the piston when the valve is open.

The carburetor proper consists of a vertically arranged spiral partition *B B*, extending from the top of the casing *A* down to a point near the bottom, leaving a small space beneath the lower edges of the convolutions of the spiral, through which the liquid contained in the carburetor may pass freely and be constantly maintained at an even saturation throughout the apparatus. The liquid is introduced into the chamber through a filling nozzle, as shown at *F*, and is maintained at a sufficient depth to fill from one-half to two-thirds of the chamber.

E is a pipe extending into the top of the chamber *A*, and having its lower end very near the bottom of the chamber and beneath the surface of the liquid. This pipe is placed at the outer end of the spiral, and when the engine is in motion air will be drawn into the carburetor through this pipe by the stroke of the engine piston. This air being delivered beneath the surface of the liquid causes a considerable agitation, and by its ebullition through the liquid it becomes charged with the vapor, while its passage over the surface of the agitated liquid, following the channels made by the spiral, will complete its saturation, so that when it has reached the center, where it is delivered upward into the chamber or extension *C*, it is sufficiently saturated for the purposes of the engine. At each stroke of the piston, when the valve is open to allow the cylinder to receive a charge, vapor is drawn into the cylinder from the chamber *C*, and a corresponding amount of air is drawn through the pipe *E* into the carburetor, the chamber *C* being thus supplied with successive charges during the operation of the engine only. It will be seen that by this construction the air is drawn through the apparatus by means of the vacuum produced by the engine piston, and that there is no chance for leakage by forcing the vapor out through any openings in the carburetor. The pipe *E* acts as a seal to prevent any return of the air which has been drawn into the apparatus, and the flexible diaphragm *D* acts as a relief, vibrating easily with each stroke of the piston. The amount of air drawn into the carburetor at one stroke passes into the engine cylinder at the next stroke, and it will be manifest that only so much air is carbureted at each time as will serve for the following stroke of the engine piston, the operation ceasing instantly when the engine stops.

The Foulis Regenerative Furnace.

U. S. Letters Patent (No. 418,314) were granted, on December 31, 1889, to Mr. William Foulis, Glasgow, Scotland, for improvements in "regenerative gas retort furnaces," the protection sought for being supplementary to that obtained by the inventor in England on June 19, 1886, the serial number of the English patents being 8,157. Although the Foulis system has been described in the JOURNAL, we are inclined to the view that the publication of the inventor's specifications in respect to the American patent will not be without interest. Mr. Foulis says:

In regenerative gas retort furnaces, as at present arranged, combustible gas produced by partial combustion of fuel in a gas producer enters the combustion chamber, where it meets and burns with air heated by its passage through flues arranged side by side with those which carry off the waste products of combustion.

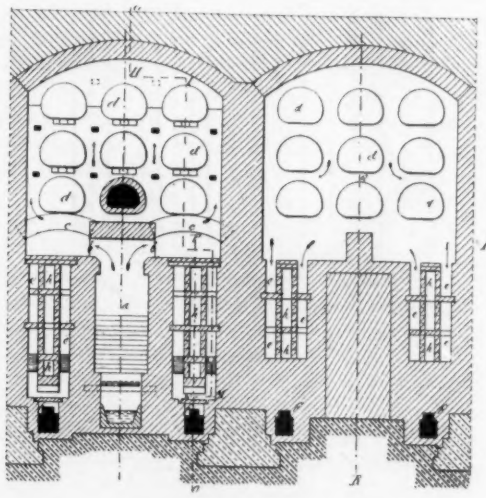


Fig 1

Usually the gas enters the combustion chamber in a horizontal direction and the hot air rises vertically to meet it, so that the main heat of the combustion is directed immediately upon the structure above, causing rapid deterioration of the structure, and producing deposits and incrustations which seriously interfere with the free passage of the gases and render necessary frequent stoppage and repairs.

The object of the present invention is to remedy this evil in such furnaces, which is effected in the following manner: The hot air flues, instead of opening vertically into the combustion chamber, are continued beyond the point where the gas enters it. They are then directed upward to about the level of the combustion chamber and open with widened mouths into the flame chamber, where the air meets the gas and enters into combustion with it. The gas and hot air being thus made to meet on the same level as they are moving horizontally, the flame, instead of being directed upward, impinging on the structure above, and causing intense local heat, sweeps freely along the flame chamber, delivering its heat uniformly over the furnace without such local intensity as can damage the structure. It is found, moreover, that by thus permitting the flame to take a free course, impinging as little as possible on any solid obstacle, more perfect combustion and complete evolution of heat are secured.

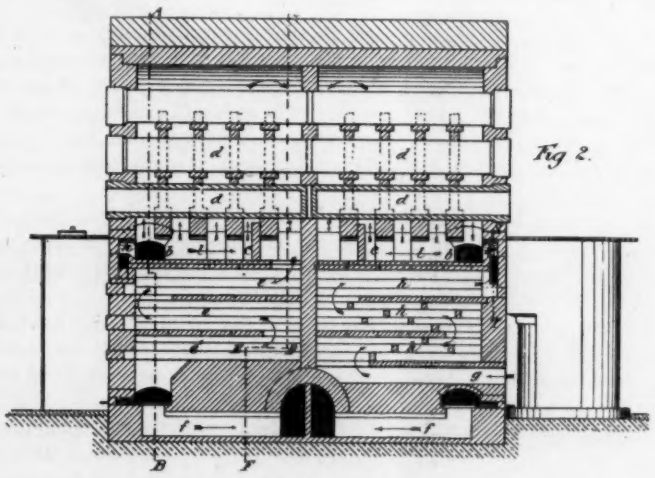


Fig 2.

The accompanying drawings are vertical sections showing this invention applied to a regenerative gas retort furnace, these sections being taken on different planes, as follows:

Fig. 1, in its left half, is a section on *A B*, and in its right half on *C D E F*, of Fig. 2, which on its left half is a section on *G H I K L M N O*, and on its right *G H I K P O*, of Fig. 1. Fig. 3 is a section on *Q R*, of Fig. 1, and Fig. 4 is a section on *S T*, of Fig. 2.

The gas generated in the producer *a* passes by the flues *b* into the combustion chamber *c*, where it meets with the supply of heated air and burns. As indicated by the arrows, the flame, which is mainly developed in the chamber *c*, and the products of combustion circulate between and around the retorts *d*, and then the products descend along the zigzag channels *e* to the flues *f*, whence they pass to the chimney shaft. The air entering at *g'* ascends the zigzag channels *h*, which are arranged between the channels *e*, and separated from them by thin partitions, so that the air in its ascent along the channels *h* becomes heated. The uppermost channel *h* is extended beyond the mouth of the gas flue *b*, and an uptake from its end expands, as shown in Fig. 4, to a wide mouth *k*,

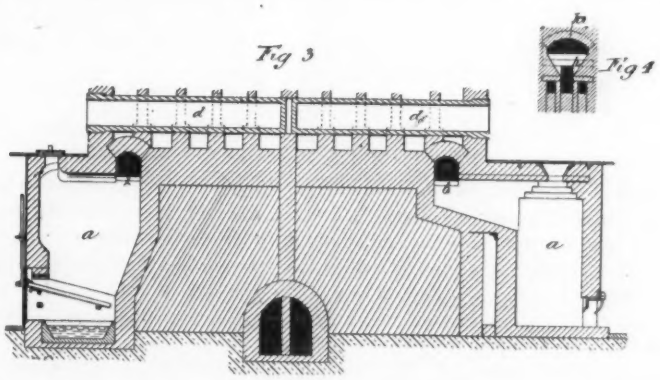


Fig 3 Fig 4

opening into the combustion chamber *c* at or about the same level with the gas flue *b*. Thus the heated air directed across the stream of gas mingles with it, supporting combustion and producing a gentle flow of flame along the chamber *c* (indicated by the arrows *l*), the flame and products thence diffusing themselves among the retorts.

Instead of a single mouth to the gas flue *b* and the air supply *k*, there must obviously be several mouths, so as to subdivide the gas and air into several streams directed either obliquely across or parallel to one another, so as to produce a flame traveling horizontally along the combustion chamber *c*.

I claim:

In a regenerating gas furnace, a combustion chamber, the walls thereof provided with horizontal air passages and horizontal gas passages opening into the said chamber in the same horizontal plane, near the bottom thereof, whereby the resultant flame is caused to travel horizontally near the bottom of the chamber before rising, as and for the purpose described.

The Deterioration of Electrical Conductors.

M. Firmin Larroque has published an account of some of his observations on the deterioration of copper conductors by the long-continued passage of strong currents of electricity through them. His attention seems to have been first called to the question in 1884, when he examined the electrical and mechanical properties of some pieces of electric lighting cables that had been in use for some years. One specimen—a portion of a cable which had conveyed electricity to a lighthouse lantern for a period of twenty years, gave very striking results. It was extremely brittle, and broke in fragments under the hammer, whilst its fractured surface resembled in all particulars that of electrolytic copper. The current through this cable had not been in any way excessive, nor had it been subjected to any heavy mechanical straining. Similar though less marked results were obtained with other cables, which had been in use for shorter spaces of time. The currents in all these cases were direct, but a portion of the secondary circuit of a small Rumkorff coil, for many years employed in igniting the gas of a Lenoir gas engine, gave M. Larroque an opportunity of examining the effects produced by an alternating current. This coil had become very brittle, and broke up during the process of unwinding; its electrical resistance, moreover, had increased about 31 per cent. during the years it had been in use. M. Larroque then determined to make some systematic experiments on this subject. He endeavored in the first place to determine whether the long-continued passage of a powerful current of electricity

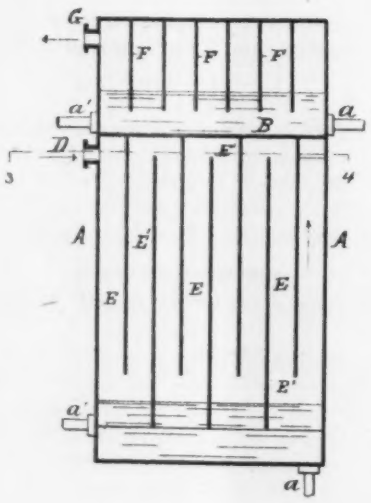
caused any expansion of the wire, and secondly, whether, and in what degree, it altered the elastic properties of the material. For each experiment nine pieces of copper ribbon 10 mm. broad and .3 mm. thick, were provided, and for the second of the experiments, each specimen was bent into a zigzag of 80 bends. One end of the zigzag was attached to a rigid support, and from the other a weight of 10 grammes was hung. Some of the specimens were hard drawn copper, and the others were made from the annealed metal. Through seven of the nine specimens a current, in some cases alternating, in the others direct, and ranging in different cases from .5 to 2 amperes was passed, whilst the other two specimens, one of which was hard drawn and the other annealed, were kept as standards, so as to eliminate any changes arising from causes unconnected with the passage of an electric current. Should the elasticity of the specimens be altered by the current, the position of the 10-gramme weight would of course vary correspondingly, and means were taken for the accurate estimation of such changes. During the first nine months of the four years over which the experiments have been prolonged, the observations showed a want of uniformity, but since then have been very regular, and the results now published show that the elastic properties of the wires have been very considerably changed. This variation takes place the more rapidly with strong than with weak currents, and with alternating than with direct.

The Kusnezov Gas Washer.

Vassily Kusnezov, of St. Petersburg, Russia, has been granted protection in this country (Letters Patent No. 415,646, Nov. 19, 1889) for a gas washer for application to gases obtained from naphtha or crude petroleum. Referring to the drawings, Fig. 1 represents a vertical section on the line 1 2, Fig. 3; Fig. 2 is a perspective view with the top and two adjoining sides cut off; and Fig. 3 is a sectional plan view on the line 3 4, Fig. 1.

The washer consists of a metallic casing *A*, preferably of rectangular form. This casing is divided by a horizontal partition or plate *B* into two compartments or chambers, in communication with each other only by a vertical pipe or duct *C*. The lower chamber, into which the gas to be purified enters by the openings *D*, is divided by vertical partitions *E*

Fig. 1.



and *E'*, which cross each other at right angles and form a great number (from 64 to 500) of vertical chambers or ducts, communicating with each other alternately at the bottom of the casing above the level of the water contained therein, and at the top immediately under the partition *B*. By this arrangement the gas must pass in a circuitous course consecutively through all the vertical channels and ducts of the lower chamber, as shown by the arrows in Figs. 2 and 3, until it reaches the last vertical duct *C*, which leads to the upper compartment. The partitions *E'*, beginning at some distance from the plate *B*, do not reach the bottom of the casing (see Figs. 1 and 2), so that the water is at the same level in all the channels or ducts. In passing under the lower edges of the partitions which do not reach down into the water the gas is brought into contact with the water, which retains the particles of naphtha contained in the gas (and which escaped the hydraulic main), and is thereby cooled and purified. After passing through all the channels or ducts of the lower chamber the gas ascends through the tube or duct *C* into the upper chamber, where it passes over a layer of water, with which this chamber is filled to about one-third of its height. In this upper chamber there are arranged a number of metallic partitions *F* parallel to

Fig. 2.

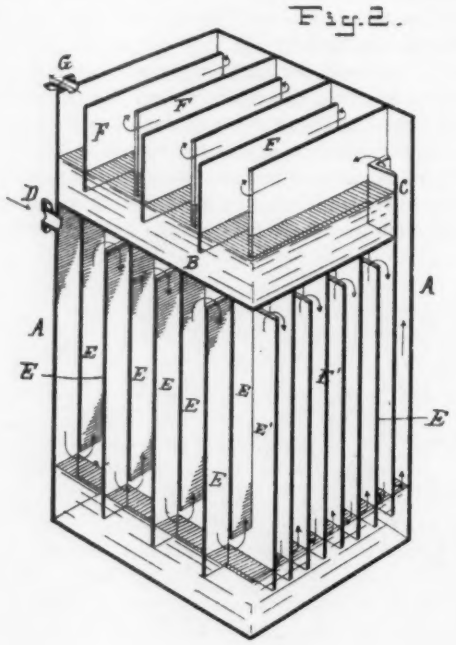
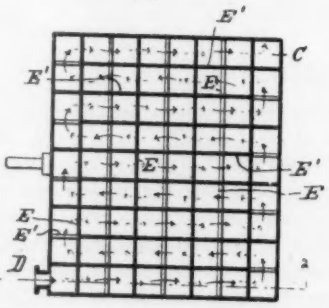


Fig. 3.



each other, and alternately open at opposite ends, so as to form a serpentine channel for the extended flow of the gas over the water, by which it is finally purified, and is let off from the apparatus by the opening *G*. An inlet *a* and outlet *a'* for the water are provided for each chamber.

The Incandescent Light Controversy.

The *Scientific American* believes that the controversy now in progress between the promoters of the rival systems of incandescent lighting, though some will think of doubtful expediency, so far as the companies are concerned, admirably serves to acquaint a public now grown timorous, with the detail of operation, and with the nature of precautions which, if employed, would render both systems entirely safe, at least to the user.

With perceptions sharpened by constant investigation, the rival champions have each in turn pointed out the defects of the other's system of lighting—defects which, because of the reticence of the companies, have till now only been surmised by the public.

It is the purpose of this article to examine these as they have been pointed out, inquiring as to the mischief that might come, and describing the steps which the studies of practical electricians show to be necessary for their correction.

The alternating current system, the attack on which led to the present controversy, is used very generally on both sides of the water for incandescent as well as for arc lighting; its chief recommendation being the powerit possesses to light extensive districts from a single station. In an arc light circuit the current reaches the lamps directly from the conduct- the voltage varying, according to requirement, from 1,200 to 2,000. In ors, the incandescent system this high voltage is maintained in the street circuit, but by the interposition of converters or transformers, located in or near each building, a secondary current of scarcely more than 50 volts is produced. This is suitable for operating a number of lamps, each equal to a full working five-foot gas burner of 16-candle power. The

transformer is made up of two separately wound and insulated coils, one of thin wire connected to the street mains, and the other of thick wire connected to the wires of the building to be lighted; currents sent through the coil of thin wire induce in the nearby coil of thick wire currents the voltage of which bears the same ratio to that of the primary current as the number of convolutions in the primary bears to the secondary coil of the converter. For example, if the electromotive force of the primary or street current is 500 volts, and the electromotive force of the secondary current is required to be 500 volts, the primary coil will require ten times as many convolutions as the secondary. The promoters of this system say that it is an easy matter to make the insulation between the two already separated coils effective and to prevent the current in the primary wire from penetrating it. On the other hand, their rivals say that no system of incandescence which has a high tension current behind it can be rendered absolutely safe, that breaks or leakages will come, because the mechanisms of man, however ingenious, are never perfect, and human watchfulness and foresight not to be depended upon. They instance the case of the employee of the Manhattan Electric Light Company, who got his death shock while carrying a portable incandescent light in the engine room of the station, a lamp, be it said, supposed to be protected from the main current by a converter. There would seem to have been a break in the insulation of the wire, which his hand must have rubbed against, his face perhaps touching a steam pipe, thus forming a ground. The station men say that only 120 volts were on the circuit, but as this would not destroy life, it is evident that the high pressure alternating current must have reached the wire, and passing through his body, got to the ground through the steam pipe.

This, however, happened within a station, and it is claimed cannot be construed as an argument against the safety of the system any more than the death of a man who should fall against a fly-wheel could be used against steam engines. The alternating current people say, and truthfully, it would seem, that the record does not furnish proof of a single case of death among the thousands who have been using the system where applied to incandescent lamps.

The continuous low tension system is that used in the circuits of Mr. Edison. Here the voltage on the street circuit, varying between 100 and 200, even the higher pressure not in the least dangerous to life, is the same on the house circuit. All underground mains are meshed into one network, and while in the alternating system the wires are designed to supply only about 1,500 to 2,000 lights per pair, and made of such a size that there is scarcely any decrease in the intensity of the lights at the further end, even when the demand for current is excessive, the low tension system at times calls for an enormous electrical energy, the pressure being far greater nearest the station than away from it. At times, when the switch is worked to put out the lights in a certain district an arc of blue flame is formed which must be blown out. This charge, made by a rival company, though true, is misleading, because the arc is harmless, never known to do any harm. The charge is made against the Edison system that it is subject to leakage which at times leads to fire. But it does not and cannot take life, while leakage from the alternating street mains can take life as well as start fires.

As will be seen, both systems have striking advantages, and to all appearance are fairly safe. Disinterested electricians, however, insist that to be rendered incapable of harm, where high tension currents are permitted in the streets, whether overhead or underground, every wire entering a house should be provided with a cut-out of lead or its alloy. It is a simple and inexpensive precaution by which a wire, however dangerously environed it may be, cannot transmit a high tension current beyond a certain point. Copper fuses at about 2,000° F., but lead at 608°, and its alloy at about 375°, and thus a strip of lead joining the house system with the outside current would melt and break off all connection should a vagrant current of high intensity essay to pass.

Coke and Charcoal Compared.

The *American Manufacturer* calls attention to the results of the following experiments, published by Dr. W. Thoerner, in *Stahl und Eisen*, in the matter of the comparison of coke with charcoal. He finds:

1. That charcoal consists of a large number of more or less regularly arranged cells which are joined together longitudinally. The walls of the cells are readily porous to gases, and are very easily oxidizable.

Coke, on the other hand, contains generally separate unconnected cells or groups of cells, the walls of which are composed of a dense and vitreous mass which does not admit of the passage of gas through it, and is exceedingly difficult to oxidize.

2. That the relatively smaller action in blast furnace practice of coke as compared with charcoal would be increased were it possible to cause the structure and character of coke generally to more closely resemble that of charcoal, either by the formation of a coke more porous though sufficiently strong, or with greater certainty by rendering the coke substance more easily oxidizable.

The following table gives the results of the examination of several specimens:

Variety of Fuel.	Ash per cent.	Specific Gravity.		In 100 Grammes Coke.		Volume of 100 Grams of Coke.
		Apparent.	Real.	Cell Space Cubic Centimeters.	Coke Substance, Cu. Centimeters.	
1. Retort coke, Osnabruck Gas Works	3.8	1.825	0.850	61.6	54.8	116.4
2. Retort coke, Osnabruck Gas Works	7.5	1.811	0.868	60.6	52.2	115.2
3. Compressed coke, Cologne-Musen Co	7.7	1.852	0.974	48.6	54.0	108.6
4. Compressed coke, Cologne Musen Co	6 9	1.786	0.909	40.2	56.0	103.2
5. Ordinary Coppee coke, Cologne-Musen Co	7.99	1.880	0.926	54.8	53.2	108.0
6. Carlsgluck and Planetfeld, Dortmund coal field	7.8	1 825	0.909	55.2	54.8	110.0
7. Maassen, low level	7.3	1.852	0.890	54.4	54.8	112.4
8. Westhausen, Bodelschwingh	10.6	1.852	0.909	54.8	54.0	108.8
9. Neu-Iserlohn, Langendreer	8.8	1.852	0.874	60.4	54.0	114.4
10. Dannenbaum, Bochum	8 45	1.894	0.800	59.6	52.8	112.4
11. Germania Works, Grevenbruck	7.6	1.909	0.963	58.4	52.4	110.8
12. Heinrichshutte, Au, a. d. Seg	7 6	1.887	0.980	49.0	53.0	102.0
13. Meiler coke, Silesia	2.9	1.488	1.646	28.4	67.2	95.6
14. Fine charcoal	2.9	1.626	0.382	200.4	61.6	262·0
15. Oak charcoal	2.45	1.347	0.587	96 2	74.2	170.4
16. Beech charcoal	2.10	1.481	0.594	100.8	67.6	168.4
17. Birch charcoal	1.65	1.351	0.484	132.5	74.0	200.5
18. Anthracite	9.3	1.666	1.572	3.6	60.0	63.6
19. Bituminous coal	8.30	1.323	1.300	1.4	75.6	77.0

In comparing these results, Dr. Thoerner observes that amongst the coke samples examined the meiler coke has the least porosity—28.4 cubic centimeters per 100 grammes—and the ordinary retort coke the greatest—61.6 cubic centimeters. The porosity of coke produced in ordinary ovens varied from 54.8 to 59.6 c.c. per 100 grams., a notable exception, however, being the "pressed coke," Nos. 3 and 4, produced on the Lurmann system, in which the porosity is only about 47 c.c. on the same weight of coke.

The porosity of the charcoal varied between 96.2 cubic centimeters and 200.4 cubic centimeters per 100 grams., and it is curious that pine charcoal, the most porous of the varieties examined, possessed the densest charcoal substance.

Microscopical examination of the form and size of the cells and the strength of the cell walls necessitated the use of thin sections, which were photographed under the microscope by Dr. Thoerner and engraved for his paper. It was observed that the smallest details of the structure of the original wood were preserved in charcoal, the arrangement of the cells being such that the gaseous products of coking could escape easily, and therefore in burning the charcoal oxygen could easily enter. The charcoal substance is not fused by coking, but remains in an easily combustible form, whilst the coke substance is found to be fused into a dense, impenetrable, vitreous mass.

Experiments on the resistance to crushing stress shown by the different varieties of coke were found to give erroneous results when the coke was carefully turned into a cylindrical form. Mr. John Fulton, of Johnstown, in his investigations on the physical properties of coke, relied greatly on the indications of hardness given by resistance to crushing stress, but Dr. Thoerner remarks that the use of cubes, as employed by Mr. Fulton in his experiments, is open to the objection that it is almost impossible to obtain from such a brittle material cubes of exactly the same size, and that he found that cubes produced were never free from slight cracks. It was, however, shown by the experiments with cylindrical test pieces that, as a general rule, the crushing strain of coke was from 0.97 to 1.73 kilograms. per square millimeter of surface, but as the results agreed very badly, a further series of tests was made in which the coke was cut to pieces of about 10 millimeters diameter, surrounded by an iron jacket and put under a piston, by means of which it was subjected to a crushing stress. The volume to which the coke was compressed by successive increasing loads was noted after each load, and

the results showed that the relative strength or compressibility was, as a rule, directly dependent on the porosity, both in the case of charcoal and in that of coke..

In the following, Sir I. Lowthian Bell's line of investigation into the relative resistance of coke and charcoal to carbonic acid, Dr. Thoerner subjected the specimens to a preliminary heating at a white heat in a current of hydrogen, and found a considerable loss in some cases.

The following numbers show the decrease in weight per cent.

No. 2.	Retort coke	0.25
No. 3.	Compressed coke	1.41
No. 4.	Compressed coke	1.15
No. 5.	Coppee coke	1.13
No. 6.	Carlsgluck, etc., coke	1.55
No. 7.	Maassen coke	1.70
No. 8.	Westhausen coke	1.70
No. 10.	Dannenbaum coke	0.75
No. 13.	Meiler coke	29.70
No. 14.	Pine charcoal	17.90
No. 15.	Oak charcoal	13.20
No. 16.	Beech charcoal	11.80
No. 17.	Birch charcoal	13.20

The above considerable loss in the case of Meiler coke and others is explained as being due to the escape of hydrocarbons and not to evolution of water.

In examining the action of carbonic acid and of air on the specimens, 1 gram of each sample of coke and 0.5 gram of each variety of charcoal were placed in a platinum tray, and heated in currents of air or carbonic acid for different periods with the following results :

Fuel	Heated in Carbonic Acid (Loss Per Cent.)			Heated in Air
	For 15 Minutes. 500 c. c. CO_2 used.	For 30 Minutes. 1 Liter CO_2 used.	For 2¼ Hours. 5 Liters CO_2 used.	for 10 minutes. 4.5 liters air being used. Loss Per Cent
1. Retort coke	....	10.6	27.2	46.8
2. Retort coke	....	11.8	36.6	45.0
3. Compressed coke	....	13.8	38.0	52.0
4. Compressed coke	....	8.4	27.2	48.9
5. Coppee coke	....	8.7	27.5	50.1
6. Carlsgluck coke	....	8.3	20.3	54.4
7. Maassen coke	....	8.9	29.3	54.5
8. Westhausen coke	....	9.5	26.2	52.9
9. Neu Iserlohn coke.	....	12.2	34.0	46.8
10. Dannenbaum coke.	....	6.8	22.6	57.1
11. Germaniahutte coke	....	8.9	32.0	52.1
12. Heinrichshutte coke	....	6.9	24.3	52.5
13. Meiler coke	...	45.6	100.0	87.7
14. Pine charcoal	61.1	96.3	....	100.0
15. Oak charcoal	48.8	85.0	....	78.6
16. Beech charcoal	60.4	95.0	....	80.3
17. Birch charcoal	68.0	95.0	....	100.0
18. Anthracite	....	....	....	45.4
19. Bituminous coal	....	....	....	74.4

Chimney Proportion.

A foreign contemporary calls attention to the fact that the rearing of high chimney shafts in connection with factories, chemical works, etc., constitutes a specialty in building construction, and may fairly be considered as a matter of very considerable economic importance.

We do not propose in the present paper to go at all practically into the details of high chimney construction. Readers desirous of information on this subject may be safely referred to Messrs. Robert M. Bancroft and Francis J. Bancroft's excellent book on the subject, which is an exhaustive and authoritative resume of the matter.

Our present purpose is to call attention to some articles which appeared not long since in a German technical contemporary on the matter, and which considered it with special reference to the question whether decrease in height of factory chimneys might not effect a saving of fuel without impairing general efficiency.

Herr P. Huth records a case in which the erection of a new boiler in a relatively disused building necessitated (after an unsuccessful attempt to use it) the demolition of the old chimney, the dimensions of which were: Height, 65.61 ft., lower diameter, 19.68 in., diameter of interior of chimney, 13.78 in. The entire length of the draught, including the flue, was about 98.42 feet. In the new chimney the entire length of the draught, including the flue, was proposed to be about 95.14 ft., and the diameter at the narrowest square portion, 25.59 in.

Partially for experimental purposes and partially with a view to economy, a trial was made of heating the boiler when the chimney was 39.37 ft. in height. Although the results were affected by the damp masonry, there was a distinct improvement perceptible as compared with the old chimney. At a height of 45.93 ft. the trials were still more satisfactory, and at 52.49 ft. all requirements were completely fulfilled, the smoke being absolutely white and sometimes scarcely noticeable, without any soot or flying ash. The heating of the boiler was excellent, and the consumption of coal 15 to 20 per cent. less than was the case with the old chimney. The top was then finished in the usual way, without any further improvement or addition to the height.

From these facts Herr Huth deduces the fact that not only the height, but also the diameter of a chimney in proportion to its height, demand attention for economic and administrative reasons. High chimneys are, he considers, as a rule too narrow in proportion to their height, and hence do not draw well, or else waste fuel and cover the neighborhood with soot and flying ash. The effort to remedy these evils by still further increasing the height of chimneys leads to their aggravation.

Herr Huth suggests more detailed researches as likely to elucidate the subject further. In a later number of the same journal, Herr Ramdohr, of Gotha, confirms the assertion that there is a dearth of exact information as to this point. He alludes to the opposite extremes of making chimneys decrease or increase in their internal diameter at the top as compared with the base. He recommends uniform diameter, and thinks that this should be estimated rather fully, in order that the heated gases in the center of a chimney may be, if possible, surrounded by a cooler stratum which protects the brickwork to some extent from the heat.

This uniformity of diameter can be obtained by cutting the bricks or by dividing the chimney into sections and ascertaining that no portion of these had less than the minimum diameter. This diameter can be estimated in proportion to the extent of the grate surface of all the fireplaces which the chimney serves, being about equal to the flue grate surfaces. This varies with different combustibles, brown or mineral coal, wood, etc., from one-eighth to one-fourth of the entire grate surface. The lower a chimney the larger may be its cross section.

The height, even when the boilers are small, should not be less than about 50 ft. For large steam appliances a height of 100 ft. to 120 ft. will usually suffice, providing the cross section be suitable.

When the fireplaces are some distance from the chimney, the height of the latter would be about 160 ft. to 200 ft., the cross section being modified on account of the coating of the smoke gases during their passage.

As to the form of the cross section of such chimneys, it is considered that a circular shape is preferable on account of its resistance to the wind pressure. An octangular form is considered a very suitable alternative, as only one special shape of brick is indispensable; and finally, it is stated, that the top of the chimney should not be called upon to bear any but a very slight projection, the whole being carefully surmounted with iron round the top of the brickwork.

Petroleum Market for 1889.

Messrs. Watson & Gibson, in an article specially prepared for a New York city contemporary, thus review the course of the petroleum market for the year 1889 :

The year 1889 opened with a dull market in petroleum, at something of a decline from the latter days of 1888. The highest price during the first week of this year was 85⅝ cents. The total net stock on the 31st day of December amounted to 18,595,474 barrels. Early in the month of January a conference took place between the representatives of the Standard Oil interest and the organized producers, resulting in a harmonious agreement between them. By this agreement the Standard extended the time of a "call" of 3,500,000 barrels until July 1st, and the Standard agreed that it would at that date accept any of this reserve oil which might remain unsold at a net profit to the producer of at least five cents per barrel. The Standard were to continue to carry this oil until July 1st, or till any previous date, when it might be called by the producers. This agreement, being a continuation of an option previously existing, did not have any very important effect upon the price of oil. From the first of the year up to the present time there has been a continual and steady reduction of the stock of oil above ground, but this gradually improving change in the situation did not begin to assert itself until the present autumn, and then only in a very moderate and indifferent sort of a way. The prices during the early months of the year ranged between 85 and 92½, falling to 80 cents the latter part of April. On the 24th of June, being just prior to the expiration of the "call" held by the producers, there was an important change in the temper and extent of speculation in the oil market, and the total dealings on that day in the Consolidated Exchange ran up to 4,910,000 barrels. The price on that day advanced from 83⅞ cents at the opening to 95, reacting before the close to 89¾. This was not only an important advance, but an utter surprise to speculators and traders. On the 28th of June the Standard purchased from the producers the 3,500,000 barrels of oil which they had been carrying, subject to a "call" by the producers. They paid for it 91½ cents. By this trade the producers made something over $200,000, and the relations between themselves and the Standard, which began in November, 1887, at the time of the original shut down movement, were terminated.

The price during the early part of July held around in the vicinity of

90 to 92, but on July 20th it rose to 95½ cents, and on July 27th to 102¼, having on the latter day advanced from 95¼ cents. These higher prices naturally resulted in an increase of development work in the field, which gave a larger production during the autumn months than had previously been turned out. The total exports for refined oil for the fiscal year ending June 30th were 496,691,346 barrels, against 452,855,695 the year before. Early in the present autumn oil advanced above $1.12 and there was a good deal of talk about very high prices for it, but speculation was almost at a standstill and the constantly decreasing stock of oil did not create any enthusiasm among buyers, or any adequate speculative response.

The growth of the Russian oil business and its successful introduction on an enlarged scale in the far East, and the completion of a pipe line across the Suram Pass, which lies between Baku and Batoum, are important features to be considered in estimating the value of American oil.

Secondly, the existence of a large field in Ohio, the visible supply of which equals the visible supply of Pennsylvania oil, selling at about one-sixth the price of the latter, exercised a bearish or at least deterrent influence on would-be buyers. It is not an established fact that Ohio oil can be economically refined, but it is stated to be a fact that its refining is chemically possible, and, as the production is now at the present low price, fully half the production in Pennsylvania, and its possibilities of increase are very great whenever its price shall be advanced, it remains a constant menace to the prices of Pennsylvania oil. The oil dealt in on the exchanges is Pennsylvania oil, and since the new oil coming out of the wells of Pennsylvania commands a premium of about 25 cents, none of the fresh oil goes into the tanks covered by the certificates dealt in on the exchanges.

The oil now in the custody of the pipe line companies, which is a good delivery on the exchanges, is the old Bradford and Alleghany oil, and it is deteriorating by age. We believe that Ohio oil will be utilized for the production of illuminating fluid and the Standard has for some time had a large refinery at Lima. It may be feasible to blend Ohio with the Pennsylvania oil. In view of all the conditions surrounding the business, the utter and complete absence of all speculative desire on the part of the public, and the interest which the Standard must have, as the chief consumer of petroleum for conversion into refined, we cannot see our way to recommend purchases of Pennsylvania oil at current prices, notwithstanding the apparently strong and bullish complexion of statistics. We think that the price of Pennsylvania and Ohio oil must be more closely approximated, and we predict that within the year 1890 the Standard will openly admit what they now deny, that Lima oil can be successfully and economically refined.

Fluctuation in Prices per Barrel (40 gals.) of Petroleum during 1889.

(Consolidated Stock and Petroleum Exchange.)

Months.	Opening.	Highest.	Lowest.	Closing.	Sales.
January	88⅝	88⅝	84	85⅜	18,369,000
February	85½	92½	85½	91½	323,040,000
March	90½	93	88⅝	92⅜	14,031,000
April	90	91½	81⅜	84½	17,472,000
May	84⅜	86½	80⅜	82⅜	10,472,000
June	82½	95	82½	92½	12,956,000
July	92½	102½	91	98⅝	11,888,000
August	98⅜	100½	97	97⅞	14,818,000
September	98	....	....	....	5,851,000
October	98½	108½	99⅞	98½	13,222,000
November	107	112½	103⅛	103¼	13,664,000
December	103⅛	106½	102¾	103⅜	5,269,000
Year	88⅝	112½	80⅜	103⅜	420,152,000

(New York Stock Exchange.)

Months.	Opening.	Highest.	Lowest.	Closing.	Sales.
January	87½	88⅜	83⅞	86½	7,920,000
February	85½	92½	85¾	91¾	3,125,000
March	91⅝	92½	88½	90⅝	8,876,000
April	90½	91⅞	81⅜	84⅝	8,616,000
May	84½	86⅛	81	82½	7,884,000
June	82⅝	95	82	92¾	4,327,000
July	92¾	102	90¾	98⅝	8,251,000
August	99	100½	97½	98¼	4,023,000
September	98	101½	97½	99	2,444,000
October	98¼	108½	99	106	10,479,000
November	106½	112½	103½	103½	8,158,000
December	102½	105½	101⅞	103⅝	2,984,000
Year	87½	112½	81⅜	103¼	87,077,000

The net stocks of oil held by the National Transit Company at the end of each month in 1889 were as follows:

January	16,483,804 barrels.	July	12,004,533 barrels.
February	15,398,677 "	August	11,225,340 "
March	14,820,668 "	September	10,482,268 "
April	14,152,787 "	October	9,761,353 "
May	13,380,306 "	November	9,230,266 "
June	12,694,145 "	December*	8,750,000 "

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

It is about settled that Cleveland (O.) will appoint an official gas inspector, and that his office shall be equipped with all the modern appliances for testing for purity and candle power. The next step will be to provide for the appointment of an electric light inspector, who shall also be required to report on the average lighting value of the arcs supplied to the city.

The employees of the Laclede Gas Light Company were made happy on Christmas eve. by the reception each of a good-sized turkey. The donor was President McMillin.

Jamestown, N. Y., intends to install and operate an arc lighting plant on municipal account.

The competition for supremacy between the Fremont (Ohio) Gas Company and the local electric light company has terminated in the purchase of the former by the latter. The proprietors of the Gas Company are said to have received a good round sum for their property, which was valued at $75,000. During the contest gas was sold at as low a figure as $1 per 1,000, while electricity could almost be had for the asking.

The following are the bids made in response to the second call by the authorities of Boston, for the public lighting by means of arc lamps, the Mayor having rejected the bids submitted under the first call on the ground that the rates were excessive: Suburban Light and Power Company, Roxbury district, 1-year contract, 39.99 cents per arc per night; 3 years, 38.99; 5 years, 37.99; for city proper, South Boston, West Roxbury and Dorchester, 5 years, 39.74 cents; Brookline Gas Company, for Brighton district, 5 years, 40 cents; Walworth Light and Power Company, for city proper, East and South Boston, Charlestown, Roxbury, West Roxbury, Brighton and Dorchester districts, 5 years, at 40 cents. The proposals were based on all and every night lighting, arcs to be of 2,000-candle power. The award of the contract was taken under advisement. It will be noted that the Boston Electric Light Company and the Charlestown Gas Company, both of which submitted bids in the first competition, did not make a tender in the last. The Mayor, however, received letters from each of the named corporations, both conveying the information that because of the restrictions in the specifications (the second set of the latter announced that no bid would be recognized that exceeded 40 cents per arc per night) they could not assume a contract at the maximum rate named and fulfil their obligations with justice to their stockholders.

An independent authority, writing on the recent ill-advised labor agitation among the English gas stokers, says: "The gas strikes at Manchester and Salford are over. The places vacant by the ill-timed action of the leaders and the foolish complicity of the men have been to a large extent filled. Some of the old hands have returned—sadder, if not wiser, men, but many have left never to return. The rate payers of the city of Manchester and of the borough of Salford undertook to give more wages and to lessen the hours of labor. But they were not prepared to become the mere agents of the Gas Stokers Union, and to insist that none should be employed except union men. Hence they put up with some inconvenience rather than coerce the gas committees of the two corporations. No such demand has ever been made by the older unions, although strikes against non-union hands have sometimes taken place. Such strikes have usually been ineffective; they have entailed great suffering and misery, and at the best they have been won at great cost. If it is right for the men to strike against non-union hands, it is equally right for employers to insist upon employing none but non-union hands. The policy in either case is sure to give rise to a feeling of permanent hostility, and further it violates the spirit of the law which now gives to all men equally the right to combine. Recent experience shows that there is a disposition abroad to rely upon force rather than

*Estimated.

upon moral or legal right; but force only engenders force in labor conflicts."

In the meantime we might remark that the difficulty between the proprietors of the Lockport (N. Y.) gas works and their employees has been satisfactorily arranged.

Some time ago Judge Black, of the Missouri State Supreme Court, rendered a decision in respect to a case known as the "grading suit," under which it became necessary to construe certain sections of the charter of Kansas City. In his opinion Judge Black holds that the charter "is the supreme or organic law of the city, and supersedes all previous laws enacted by the general assembly of the State for the regulation of the city's affairs." Under this ruling it is now held by the municipal authorities of Kansas City that the city has the right to say at what rate gas and electric light shall be supplied. Section 12 of Article 14 of the Kansas City charter is: "*Provided*, That no such person or corporation shall in any event charge more for light for the city or private parties than the prices specified, from time to time, by ordinance of the city, and that the city shall also have power to regulate and fix from time to time the prices such person or company may charge for the renting of meters or apparatus for ascertaining the quantity of material or means consumed for lighting. And provided, further, That the city shall not, in making the original grant, nor in any manner subsequent thereto, ever agree or bind itself to pay any fixed price for lighting streets, avenues, etc., for a longer period than one year."

Articles incorporating the National Gas and Electric Fixture Company were filed at Camden, N. J., on December 30, 1889. The capital stock of the concern is fixed at $500,000, with 5 per cent. paid in. The incorporators are Messrs. Benjamin Thackara and Clement M. Biddle, of Philadelphia, H. C. Beck, of Brooklyn, N. Y., Jno. C. Cassidy, of East Orange, N. J., and Charles H. Fischer, of Mount Vernon, N. Y.

At the annual meeting of the Covington (Ky.) Gas Company, no change was made in the executive management. Colonel Amos Shinkle, President of the Company, believes that 1890 is to be a great gas year.

A correspondent, writing under date of December 29, 1889, from Kansas City, Mo., says: "Some months ago the question of removing mail boxes from the gas lamps in the city that are no longer in service because of the substitution of arc lights, came up. The posts could be removed to other parts of the city if it were not for the mail boxes attached to them, and it is but a mere matter of generosity on the part of the Gas Company that the posts have been allowed to be so used at all, even when the posts were a part of the public lighting equipment. Secretary Woolcott has informed the post office authorities that the Company would now like to transfer the posts, and has forwarded a list of the ones which it is desirable to remove, to the Postmaster. He will not insist on an immediate transfer, but will grant ample time for the removal of the mail boxes to other locations."

The authorities of Denver, Col., headed by the Mayor, have been investigating the matter of the economy involved in the operation of municipal electric lighting plants. A portion of their researches is shown in the following replies received from localities where such plants have been in operation for a year or over:

Locality.	No. lights.	Cost of installation.	Annual cost per lamp.
Bay City, Mich....	120.....	$30,280.....	$39
Madison, Ind.....	81.....	18,500.....	60
Topeka, Kan.....	120.....	26,500.....	88
Little Rock, Ark...	95.....	27,000.....	75
Wichita, Kan.....	150.....	.....	55

At Bay City water power is availed of, steam being the motor in the other instances. The annual maintenance charges do not include anything for wear and tear or interest.

In completion of our former mention of the explosion last month at the works of the Asheville (N. C.) Gas Company, in which two employees (Louis Guthrie and Wm. Gates) lost their lives, we may say that the testimony taken at the coroner's inquiry showed the accident to have resulted from the placing of a common lantern (with a light burning therein) at a point about 3½ feet from an open manhole in the gasholder crown—the gasholder having been let down for repairs—from which gas was still escaping. The verdict bluntly states that "the victims lost their lives because of the employment of incompetent men at the gas works." And the evidence more than bears out that arraignment.

Canton, Ohio, pays at the rate of $108 per annum for each arc light supplied on city account. The lamps are of the 2,000-candle power variety, and are suspended over the street centers. All-night lighting is the rule. Cleveland employs for the lighting of one square mile in the center of the city four towers (one of which is 250 feet in height, the others being 150 feet from the surface), one of which carries eight 4,000-candle power arcs, while the others carry 6 lamps, each of a like illuminating value—4,000 candles. In addition to these 78 arcs (2,000-candle power) are maintained at other points. A lighting table of 3,760 hours per annum is followed. For the mast lights the charge is 10½ cents per lamp per hour; for the others 3.7 cents per hour is the rate. It is said that the mast illumination gives the greater satisfaction.

A correspondent writes: "In the last week in December 800 shares of the Fitchburg (Mass.) Gas Light Company's stock was sold at auction. The entire block was purchased by Mr. Geo. F. Fay, who secured the shares at par. This sale was the final act in the purchase by the Gas Company of the Wachusett Electric Light Company, the arrangements for which were made some time ago. The terms of the consolidation called for an increase in the capital stock, and the shares bought in by Mr. Fay will represent that increase.—Observer."

At a recent meeting of the City Council of East St. Louis, Mo., it was resolved to accept a proposition for the public lighting, submitted by the Citizens Electric Light and Power Company, under which 60 arcs (2,000-candle power) are to be maintained for a period of 3 years, at an annual charge of $125 per light per annum. This decision is made in face of the fact that some years ago the authorities awarded a 30-year contract for the public lighting to the East St. Louis Gas Light Company, which contract will not expire until 1905. The Company will undoubtedly resort to the courts in the maintenance of its rights, but the contract-breakers are of the opinion that the Company is without redress, basing their belief on a decision of the State Supreme Court to the effect that no corporate body (in this sense meaning the municipal or local legislative authority) can legislate for a term longer than its own existence.

The proprietors of the Davenport (Iowa) Gas Light Company have kept up with the procession in the year just closed. In the twelvemonth expenditures on plant account have amounted to $29,000. Of this sum $20,000 was put into new apparatus, while $9,000 was apportioned to the street department. In the year 1½ miles of new mains were buried, and the balance of the system (27 miles) was thoroughly inspected and repaired. The Company is now in excellent shape for business, which is progressing most satisfactorily.

The Pawtucket (R. I.) Common Council has amended its contract for public lighting with the Pawtucket Gas and Electric Light Company so that the 2,000-candle power arcs now supplied on the all-night schedule may be changed to half arcs.

Superintendent Hayden, of the Fishkill (N. Y.) Gas Company, has taken advantage of the continued mild season to overhaul the main system, which, to say the least, was far from being a model one.

A St. Louis newspaper says that the talk about introducing and attempting to pass another gas bill in lieu of the vetoed Branham-Hardesty imposition is ridiculous, and then adds the following simple truths: "No additional gas works are needed in this city. The old gas trust was a pretty tough thing for the people, but the remedy is not in the direction of new companies. The history of gas legislation shows that every new company eventually increases the cost of gas by compelling the old companies to absorb it and to pay interest on increased capitalization."

The following is from the Clinton (Mo.) *Democrat*, dated the 2d inst.: "For nearly one year the *Democrat* proprietors have contemplated making an exchange of the 4½-horse power Bookwalter steam engine for a motor power for our newspaper and job presses which required less personal supervision, and at the same time suitable for all demands. A water motor was placed in position last summer, but its capacity was inadequate and again our steam engine performed its daily service. Recently, correspondence was re-opened with the Van Duzen Gas Engine Company, Cincinnati, O., for the purchase of an engine, which resulted in our placing an order by telegraph subject to 15 days trial. When the engine arrived a substantial stone foundation was put in and connection made to the gas meter. The engine has now been tested, and it gives us pleasure to say fills our highest expectations. It is simple in construction, economical in use of gas, develops full power, runs as

steady as a clock, and has come to stay as a permanent fixture in our press room. Its floor space is 4 x 4 feet, height 6 feet, weight 1,600 lbs. With not more than one-half of its 4-horse power developed, it runs with ease our 33in. by 48in. Campbell press and Dexter folder, paster and cutter and 14½ by 22 Peerless and 9 by 12 Gordon job presses. To Mr. J. T. Marsh, Superintendent of the Clinton Gas, Coal and Coke Company, the *Democrat* is under lasting obligations for his many acts of courtesy, in placing the engine in position and for instructing us in its management. He has been a citizen of Clinton over 6 years, and is always at his post of duty. Our gas engine can be seen in operation every week day, from 4:30 to 5 P.M., and Mondays and Thursdays from 9 to 12 A.M.

ACCORDING to the annual report of the Superintendent of Public Lights (Mr. J. S. Read), there are now maintained at Pawtucket (R. I.) 156 electric, 110 gas and 147 oil lights, an increase of 18 gas lights and 7 oil lights over last year. During the year 2,160 chimneys in the oil lamps were broken, while 1,586 lights of glass were broken in the gas lanterns. The total expenditure was $24,485, and the rebate on lights for the year was only $162.64.

THE Walla Walla (Wash.) Gas and Electric Light Company is building a new engine and dynamo house. A new 100-horse power engine has also been ordered.

EVEN the Knights of Labor, of St. Louis, were opposed to the Branham-Hardesty gas works grab, as shown by the action taken at a meeting of the Executive Committee of the Knights held on December 29. It must have been a decidedly tough grab when they were forced to attest its indigestibility.

THE Fuel Gas Improvement Company of Pittsburg, Pa., has been chartered.

A DESPATCH from Eau Claire, Mo., dated December 24th, says that during a violent *thunderstorm* on that date, a flash of lightning caused sad havoc to the wires of the local Brush electric company, and that a similar visitation burned out the McDonough incandescent plant.

IT is rumored that Colonel J. M. Thompson, well-known in St. Louis gas circles, may secure the appointment of United States Assistant Treasurer at St. Louis.

THE offices of the New Bedford (Mass.) Gas Company are now located in the Winslow Building. Another evidence of Mr. Taber's good taste.

SUPT. WHITEMORE, of the Bath (Me.) Gas Company, has completed the alterations at the works rendered necessary by the marked increase in the business of the Company.

THE Suburban Gas Company has been incorporated at Chicago by Messrs. R. Custer, M. Cameron and J. A. Griffin. It is capitalized in $50,000.

THE annual meeting of the Trenton (N. J.) Gas Light Company will be held to-day.

THE Plattsburgh Light, Heat and Power Company has been incorporated, with a capital of $100,000. The Trustees are A. L. Inman, Jno. H. Myers, G. M. Cole and S. A. Kellogg, of Plattsburgh, and H. M. Pierson, of Brooklyn.

IT is interesting to note how the increase in the number of gasoline street lighting contractors has gradually reduced the contract rates in various cities. Perhaps the best illustration of this is shown in the bids recently opened by the Council's Committee on Gas, Minneapolis, Minn., for supplying that city during the coming year with 2,009 or more gasoline street lamps. The bids are appended :

Bidder.	Per Post.
W. Forrestal & Co., St. Paul	$17.20
Wheeler Reflector Company	15.60
Wheeler Gasoline	15.84
Jno. Van der Horck	16.96
Chester Oil Company	16.50
N. Western Globe Gas Light Company	14.40

The lowest bid is something like $5.60 per post under the present contract rate, the work being in the hands of the Wheeler Reflector Company.

THE contract between the St. Charles (Mo.) Gas and Coal Company and the authorities for the public lighting of that place expires on the 31st inst. It is probable that an attempt will be made to have the new contract based on a mixed system of gas and electric lighting.

THE Uniontown (Pa.) Electric Light and Power Company has been chartered. Capitalized in $50,000.

THE Boston *Traveller* says that the gas people have met unsurmountable obstacles in their efforts to get control of the gas plants at Chelsea and Brighton, and as the indications now point, they are hardly likely to be successful in their move for the possession of the Waltham plant. Some of the stockholders have deposited their holdings in accordance with the request of the Directors, and under the agreement the Trustees are authorized to accept not less than $140 per share. Very many of the stockholders are not, however, satisfied with this figure, and are not inclined to come into the arrangement. This latter decision would seem to be in line with wisdom, for we fail to understand how the Waltham property can be more valuable to outsiders than to those who are so intimately acquainted with its past history, present business and future prospects.

IN the meantime, mention of the Bay State syndicate brings to mind the fact that certain people well-informed in respect to Brooklyn (N.Y.) gas matters, assert that the companies of that city are likely to come under the control of Messrs. Addicks and his associates. Speaking on our own account we are not inclined to share this view, for we presume that such men as Mr. Morgan of the Nassau Company, and General Jourdan of the Fulton Municipal Company, know pretty well when they have a good thing, and know also how to take care of it.

TESTS of the illuminating power of Hartford (Conn.) gas, made by Prof. Mixter, the State Gas Inspector, on Dec. 31, shows an average lighting value of 17.80 candles.

FROM the Springfield (Mass.) *Republican* we take the following summary of the annual report of the Committee on Street Lighting for the past year.

"The Committee on Street Lights reports that the appropriation amounted to $32,500, and the receipts, $8 from the sale of globes; the expenditures amounted to $27,437, leaving a balance unexpended of $5,071. This does not include $7,449 paid for electric light poles, which was taken from the money in the treasury not otherwise appropriated. The number of electric lights in use is 294, of gas 54, and of oil 349. There are 44 electric lights already established not as yet in operation—an increase in the number of lights established over last year of 283. The electric lights are furnished by the United Electric Light Company, of this city, under a five-year contract recently signed by this Committee, at a cost of little less than 23 cents a night for each light. The Committee believes the contract to be admirably adapted for practical use, containing no technical terms capable of a double meaning, and owing to many requests they have had from other cities for a copy, they have included this as a part of their report. The report then gives a sketch of the struggle which the Committee had to secure the new contract. After finding at the beginning of the year that the price was exorbitant, and getting permission of the City Council, the Committee served notice, February 22, on the United Electric Light Company to that effect. Then the Committee endeavored to secure an estimate from the local Company. Being unable to obtain reasonable figures an order was introduced in the City Council asking leave to advertise for proposals for lighting the city; but the Aldermen tabled the measure. Almost discouraged the Committee began to agitate the question of municipal lighting, especially from a financial standpoint. The Committee did not favor it as expedient, and except as having a tendency to induce the local Company to accept a reasonable offer. It had the desired effect, for May 22 a contract with the United Electric Light Company was signed, they agreeing to furnish 300 half-arc electric lights for $83½ a year for each light, a very satisfactory reduction from the former price of $219. This investigation was carried on at an expense of less than $20 to the city. Under the contract the city is required to furnish the lamp poles. The Committee endeavored to secure chestnut poles, but had to get of the Massachusetts Construction Company, of Boston, Georgia hard pine poles, which are believed to be equally durable. The work of setting the poles was also done by this Company. The Committee believes the contract to be very fair and reasonable, and recommends that a strict observance should be insisted on by the city. It is also recommended that the lights be tested from time to time, for electric lights, to be a success, must be of the specified candle power. Owing to the irregular streets and the unnecessary number of shade trees on many of them the Committee found it very difficult to derive the best results from lights in many localities. This has been obviated by using mast arms placing lights over the street. The arms used by the city are two patterns, the Brady, the longer in use and giving general satisfaction, and the other, the Russell, a much neater and lighter arm, equally satisfactory. It is recommended that the electric lights be increased so as to dispense as far as possible with the gas and oil lights, especially on the principal streets, where they serve the double purpose of giving light and protection. In June the Committee advertised for proposals for the care of the gas and oil lights, but owing to the greatly increased number of electric lights, no bids were received. T. W. Hamilton has continued the work at the old price, 2 cents a night for gas, and 2½ cents for oil lights, although he is under no contract. The Committee believes that the time has arrived when the city should establish by ordinance a superintendent of street lights, whose duty shall be to carefully inspect all electric lights and report any irregularities to the Committee, also to have supervision of all other lights of the city."

Advertisers Index.

GAS ENGINEERS. Page

Jos. R. Thomas, New York City 60
Wm. Henry White, New York City 65
Wm. Mooney, New York City 60
William Gardner, Pittsburgh, Pa 60
Fred. Bredel, N. Y. City 59

GAS AND WATER PIPES.

Gloucester Iron Works, Phila., Pa 60
Mellert Foundry and Machine Co., Reading, Pa. (John Fox, Selling Agent, N. Y.) 60
Ohio Pipe Co., Columbus, Ohio 60
M. J. Drummond, New York City 60
R. D. Wood & Co., Phila., Pa 62
Warren Foundry & Machine Co., New York City 60
Donaldson Iron Co., Emaus, Pa 60
Dennis Long & Company, Louisville, Ky 60
A. & W. S. Carr Co., New York City 18

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City 63
Continental Iron Works. Greenpoint, L. I 63
Delly & Fowler, Phila., Pa 63
Kerr Murray Mfg. Co., Fort Wayne, Ind 51
Stacey Mfg. Co., Cincinnati, Ohio 63
Bartlett, Hayward & Co., Baltimore, Md 61
Morris, Tasker & Co., Limited, Phila., Pa 61
Davis & Farnum Mfg. Co., Waltham, Mass 19
R. D. Wood & Co., Phila., Pa 62
Bouton Foundry Co., Chicago, Ills 63
Smith & Sayre Manufacturing Co., New York City 63
Fred. Bredel, N. Y. City 59
United Gas Improvement Co., Phila., Pa 53
Henry Pratt & Co., Chicago, Ill 59
National Gas Light and Fuel Co., Chicago, Ills 54
Simpkin & Hillyer, Richmond, Va 49

PROCESSES.

National Gas Light and Fuel Co., Chicago, Ills 54
Bartlett, Hayward & Co., Baltimore, Md 61
Wm. Henry White, N. Y. City 65
United Gas Improvement Co., Phila., Pa 53
Henry Pratt & Co., Chicago, Ill 59

INCLINED RETORTS.

Laclede Fire Brick Manuf'g Co., St, Louis, Mo 51

GASHOLDER TANKS.

W. C. Whyte, New York City 54
J. P. Whittier, Brooklyn, N. Y 49

GASHOLDER PAINT.

The Government Waterproof Paint Co., Boston, Mass 49

RETORTS AND FIREBRICK.

J. H. Gautier & Co., Jersey City, N. J 58
B. Kreischer & Sons, New York City 58
Adam Weber, New York City 58
Laclede Fire Brick Manuf'g Co., St. Louis, Mo 58
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y 58
Borgner & O'Brien, Phila., Pa 58
James Gardner, Jr., Pittsburgh, Pa 58
Henry Maurer & Son, New York city 59
Chicago Retort and Fire Brick Co., Chicago, Ills 58
Baltimore Retort and Fire Brick Co., Baltimore 58
Oakhill Gas Retort and Fire Brick Co., St. Louis, Mo 58

SCRUBBERS AND CONDENSERS.

G. Shepard Page, New York City 59
R. D. Wood & Co., Phila., Pa 62

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md 61
Fred. Bredel, New York City 59
Chicago Retort and Firebrick Co., Chicago, Ills 58
Wm. Henry White, N. Y. City 65
J. H. Gautier & Co., Jersey City, N. J 59

GAS GOVERNORS.

Connelly & Co., New York City 55
Fred. Bredel, N. Y. City 59
Friedrich Lux, London, England 48

SELF-SEALING MOUTHPIECE DOORS.

Smith & Sayre Mfg. Co., New York City 59

TAR AND CARBONIC ACID EXTRACTOR.

Geo. Shepard Page, N. Y. City 20

PURIFYING MACHINES.

C. & W. Walker, London, England 18

CEMENTS.

C. L. Gerould & Co., Brooklyn, N. Y 58

GAS ENRICHERS.

Standard Oil Co., Cleveland, Ohio 64

GAS METERS.

John J. Griffin & Co., Phila., Pa 66
American Meter Co., New York and Philadelphia 67
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa 67
Helme & McIlhenny, Phila., Pa 67
D. McDonald & Co. Albany, N. Y 67
Nathaniel Tufts, Boston, Mass 66
Maryland Meter and Manufacturing Co., Baltimore, Md 34
John Hillen, Brooklyn, N. Y 66

EXHAUSTERS.

P. H. & F. M. Roots, Connersville, Ind 62
Smith & Sayre Manufacturing Co., New York City 63
Wilbraham Bros., Philadelphia, Pa 55
Connelly & Co., New York City 55

GAS COALS.

Penn Gas Coal Co., Phila., Pa 63
Perkins & Co., New York City 64
Newburgh Orrel Coal Co., Baltimore Md 63
Despard Coal Co., Baltimore, Md 65
Chesapeake and Ohio R. R. Coal Agency, N. Y. City 63
Westmoreland Coal Company, Phila., Pa 63
J. & W. Wood, New York City 64

CANNEL COALS.

Perkins & Co., New York City 64
J. & W. Wood, New York City 64

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y 56
John McLean, New York City 56
Chapman Valve Manufacturing Co., Boston, Mass 56
R. D. Wood & Co., Phila., Pa 62
A. & W. S. Carr Co., New York City 18

GAS ENGINES.

Schleicher, Schumm & Co., Phila., Pa 68
Clerk Gas Engine Co., Phila., Pa 56
Van Duzen Gas Engine Co., Cincinnati, Ohio 56

ENGINES AND BOILERS.

Jarvis Engineering Co., Boston, Mass 55
Ball Engine Co., Erie, Pa 49
Westinghouse Machine Co., Pittsburgh, Pa 55

GAS LAMPS.

G. Shepard Page, New York City 24
Standard Gas Lamp Co., Phila., Pa 49
Welsbach Incandescent Gas Light Co., Phila., Pa 50
The Siemens-Lungren Company, Philadelphia, Pa 50

PURIFIER SCREENS.

John Cabot, New York City 56
Bartlett, Hayward & Co., Baltimore, Md 56

GAS STOVES.

American Meter Co., New York and Philadelphia 57
The Goodwin Gas Stove and Meter Co., Phila. Pa 36
George M. Clark & Company, Chicago, Ills 50

STREET LAMPS.

J. G. Miner, Morrisania, New York City 49
Bartlett Street Lamp Man'fg Co., New York City 49

BURNERS.

C. A. Gefrorer, Phila., Pa 64
H. W. Rappleye, Phila., Pa 901

STEAM BLOWER FOR BURNING BREESE.

H. E. Parson, New York City 56

PURIFYING MATERIAL.

Connelly & Co., New York City 55
Friedrich Lux, London, England 48
Edgewater Lime Works, Edgewater, N. J 48

COKE CRUSHER.

C. M. Keller, Columbus, Ind 65

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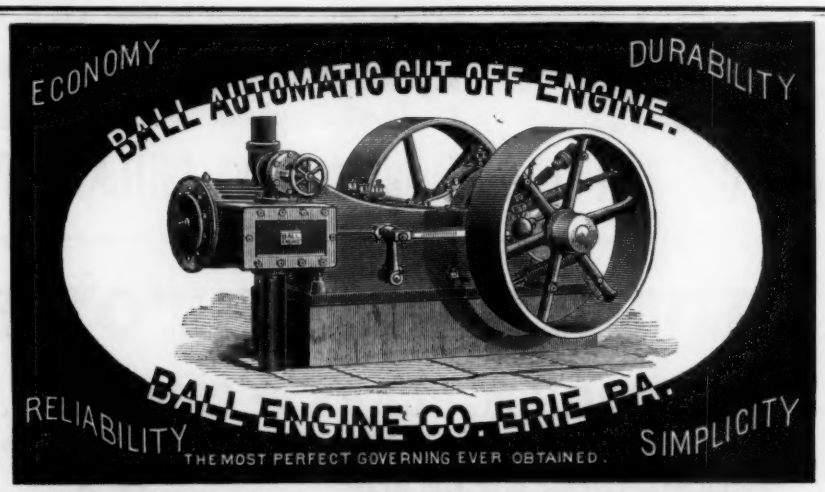

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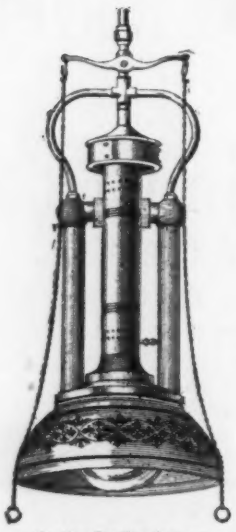

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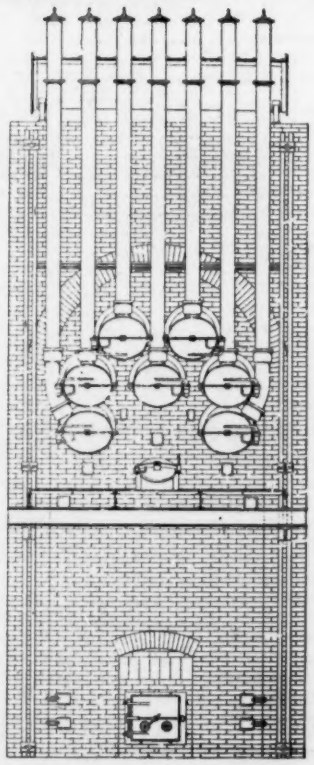

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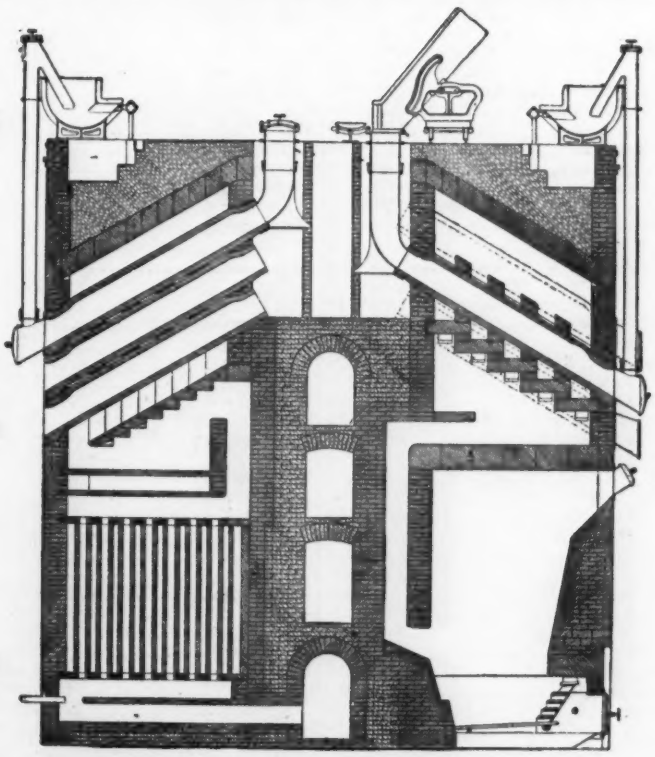

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Erected and in course of construction at present date:

	Capacity. Cubic feet per day.
Altrincham	600,000
Adelaide	600,000
Aldershot	200,000
Allegheny, U. S. A.	1,000,000
Ashton-under-Lyne	1,250,000
Amsterdam	1,500,000
"	1,500,000
Annaberg	200,000
Arcachon	100,000
Animal Charcoal Co	200,000
Altoona, U.S.A.	350,000
Buxton	250,000
Bradford	1,000,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,000,000
"	1,000,000
"	3,000,000
Bremen	150,000
Baltimore, U.S.A.	1,000,000
"	1,000,000
"	1,000,000
Balmain, N.S.W	125,000
Bishops Stortford	150,000
Blackpool	400,000
Brussels	1,250,000
"	1,250,000
"	750,000
"	1,250,000
Banbury	250,000
Birmingham	5,000,000
Birkenhead	2,500,000
Blackburn	1,500,000
Bochum	600,000
Burntisland	250,000
Boston, U.S.A.	2,000,000
Brisbane	1,500,000
"	300,000
Burton-on-Trent	1,500,000
Barcelona	350,000
Barking	100,000
Baerlien & Co	20,000
"	20,000
Bombay	400,000
Buffalo, U.S.A., Mutual	750,000
" **Citizen**	500,000
Brookline, U.S.A.	500,000
Bergen	350,000
Berlin	1,250,000
Bournemouth	1,000,000
Bridgeport, U.S.A.	500,000
Brunswick	300,000
Beck & Co., St. Louis	100,000
Barmen Rittershausen	600,000
Bexhill	125,000
Brooklyn, U.S.A.	1,000,000
"	1,000,000
" **Nassau**	1,000,000
Brunner, Mond & Co.	400,000
Cheltenham	2,000,000
Cannes	200,000
Croydon	1,500,000
Copenhagen	200,000
Clevedon	200,000
Columbus, U.S.A.	500,000
Cincinnati, "	1,500,000
" "	1,500,000
Chicago "	3,000,000
" "	1,000,000
" "	1,000,000
Chemnitz	1,000,000
Crewe	1,250,000
Colonial Gas Works Co	100,000
Cadiz	300,000
Charlottenburg	600,000
Dudley	750,000
Driffield	100,000
Dukenfield	500,000
Dover	750,000
"	1,000,000
Deal	200,000
Derby	1,500,000

	Capacity. Cubic feet per day.
Dublin	3,000,000
Dowlais	100,000
Douai	500,000
Denton	500,000
Derby, U.S.A	350,000
Denver, "	500,000
" "	1,000,000
Dusselldorf	750,000
"	500,000
Dumfries	250,000
Dunedin, N.Z	400,000
Darlington	1,250,000
Detroit, U.S.A	750,000
Edinburgh	1,500,000
"	2,000,000
Enfield	300,000
Essen	300,000
Elbing	150,000
Falmouth	150,000
Frankfort	300,000
Farnworth	400,000
Fenton	400,000
Friedenshutte	500,000
Furth	400,000
Freiburg	200,000
Goole	250,000
Glossop	300,000
Guildford	300,000
Gloucester	1,250,000
Gera	300,000
Grafton, N.S.W	100,000
Grieg	300,000
Georgetown, U.S.A	250,000
Gluckauf	200,000
Heywood	600,000
Holywood	125,000
Huy	70,000
Harrow	250,000
Harrogate	250,000
Halstead	150,000
Heilbronn	200,000
Havana, Cuba	750,000
Hastings	1,500,000
Huddersfield	300,000
"	750,000
"	1,500,000
Hof	200,000
Hampton Wick	500,000
Heckmondwicke	500,000
Haverfordwest	100,000
Halifax, N.S.	350,000
Hamm	200,000
Halle	400,000
Heidelberg	300,000
Hartford, U.S.A	1,000,000
Ilkeston	300,000
Inverness	250,000
Ilkley	200,000
Ilford	100,000
Kingston-on-Hull	400,000
Kidderminster	750,000
Kidsgrove	100,000
Konigberg	1,000,000
King's Lynn	300,000

LONDON:—

The Gaslight and Coke Co.:	
Beckton	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	1,250,000
"	2,500,000
"	2,500,000
Silvertown	1,000,000
Bromley	2,000,000
"	1,500,000
"	1,500,000
"	1,500,000
"	2,000,000
"	1,500,000

LONDON—*Continued.*	Capacity. Cubic feet per day.
Shoreditch	2,500,000
Pancras	1,500,000
"	1,500,000
Pimlico	2,000,000
Nine Elms	3,000,000
"	3,000,000
South Metropolitan Co:—	
Greenwich	3,000,000
Woolwich	400,000
Vauxhall	3,000,000
"	3,000,000
Lea Bridge	300,000
West Ham	1,500,000
Leeds	2,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	3,000,000
"	2,000,000
Leominster	150,000
Leiden	560,000
"	600,000
Liverpool	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	2,000,000
"	3,000,000
Lincoln	1,000,000
"	600,000
Lowell, U. S. A	1,000,000
Louisville "	1,500,000
Long Eaton	500,000
Lilie	900,000
"	450,000
"	750,000
"	250,000
"	250,000
Luckenwalde	330,000
Liegwitz	300,000
Lincoln, U. S. A	250,000
Lawrence "	500,000
Lynn "	300,000
Lyons	1,500,000
Maidstone	1,000,000
Marseilles	1,500,000
"	1,500,000
Mons	500,000
Malines	250,000
Melbourne	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
"	1,500,000
Manchester	2,500,000
Middleton	400,000
Manley, N. S. W.	100,000
Minneapolis, U. S. A	750,000
Magdeburg	300,000
Memphis, U. S. A	750,000
Nottingham	1,250,000
"	2,500,000
"	2,500,000
"	2,000,000
"	1,500,000
"	2,000,000
Newport, U.S.A	430,000
Newmarket	150,000
Newark, U.S.A	680,000
Northfleet	200,000
New York, U.S.A	2,000,000
Nice	600,000
Newcastle, N. S. W.	200,000
Numea, "	100,000
Namur	250,000
Newark	350,000
Oldbury	500,000
Otley	200,000
Oswestry	250,000

	Capacity. Cubic feet per day.
Ober Schlesian	1,500,000
Otto & Co.'s Coke Works	1,500,000
Plymouth	2,000,000
Parramatta, N. S. W.	100,000
Prescott	150,000
Providence, U.S.A.	750,000
"	750,000
Plauen	300,000
"	300,000
Portsmouth	2,500,000
"	2,500,000
Pittsburgh, U.S.A.	1,500,000
Portland, "	560,000
Pawtucket, "	500,000
Quebec	250,000
Radcliffe	750,000
Rouen	250,000
Ramsgate	1,000,000
Reigate	200,000
Richmond, U.S.A.	250,000
Roxbury, "	500,000
Runcorn Soap Co.	20,000
Rockhampton, N. S. W.	125,000
Richmond	1,500,000
Reading	2,000,000
Reichenbach	200,000
Salford	1,750,000
"	1,750,000
"	1,750,000
Smethwick	750,000
Sydney, N. S. W.	1,000,000
"	1,000,000
"	2,500,000
"	50,000
"	50,000
Sunderland	1,500,000
St. Josephs, U.S.A	250,000
Spa	100,000
Sevenoaks	300,000
St. Petersburg	2,000,000
"	1,500,000
St. Louis, U.S.A	2,000,000
"	2,000,000
"	1,000,000
Laclede	1,000,000
Silesian Coal Co.	600,000
San Francisco, U.S.A	2,000,000
"	2,000,000
Sheepbridge Coal Co.	40,000
Stettin	200,000
Singapore	300,000
Sutton	500,000
Tonbridge	150,000
Tipton	400,000
Tottenham	1,000,000
Toledo, U.S.A	750,000
Toronto	1,000,000
Uxbridge	300,000
Valparaiso	500,000
West Bromwich	1,000,000
Willenhall	250,000
Weston-super-Mare	500,000
Waltham	150,000
Wormwood Scrubs	300,000
Williamsburg, U.S.A	600,000
"	600,000
Wellington	150,000
Warwick	300,000
Wheeling, U.S.A	500,000
Walker	300,000
Westgate	100,000
Wilmington, U.S.A	500,000
Windsor, N. S. W.	100,000
Wolverton	100,000
Wellington, N. Z.	250,000
Whitchurch	175,000
Washington, U.S.A	2,000,000
Wallasey	750,000
Weimar	150,000
Wurzen	200,000
Worcester, U.S.A	750,000
Yeadon	500,000
Yeovil	250,000

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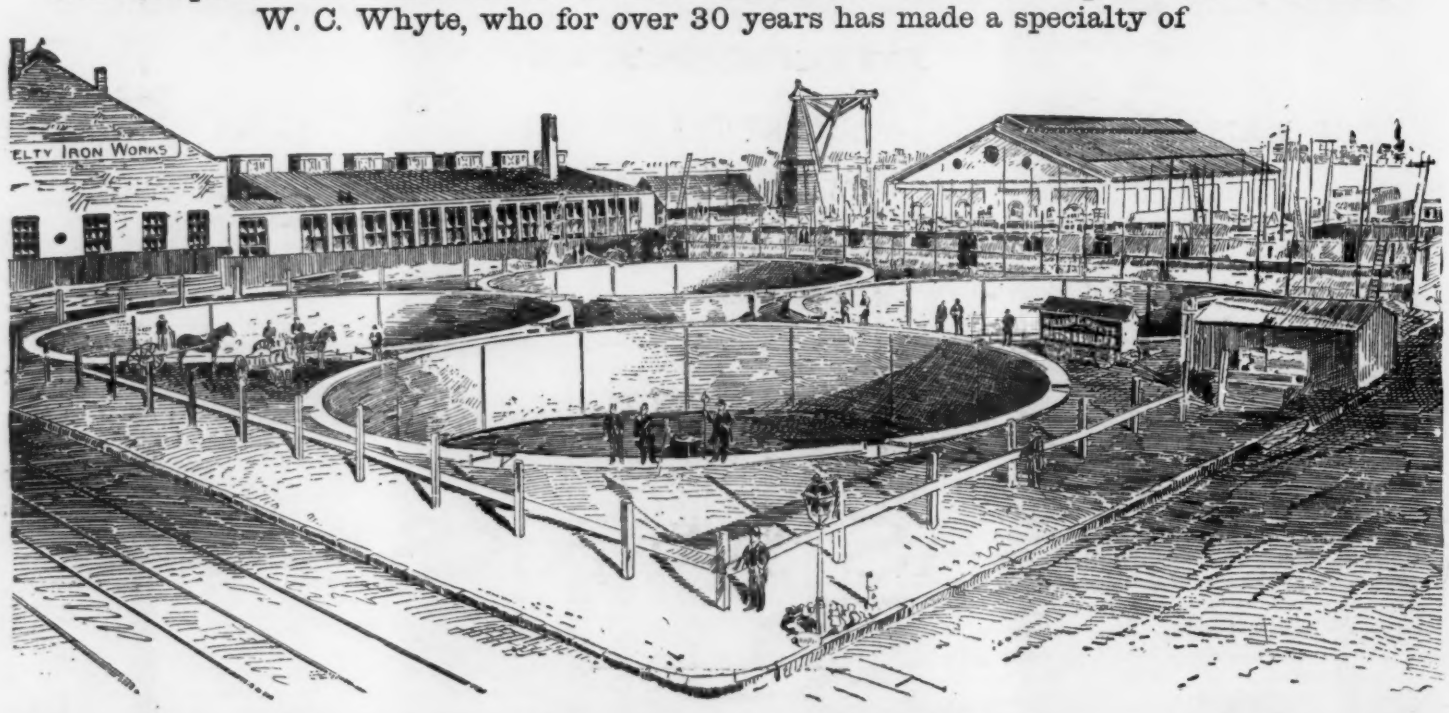

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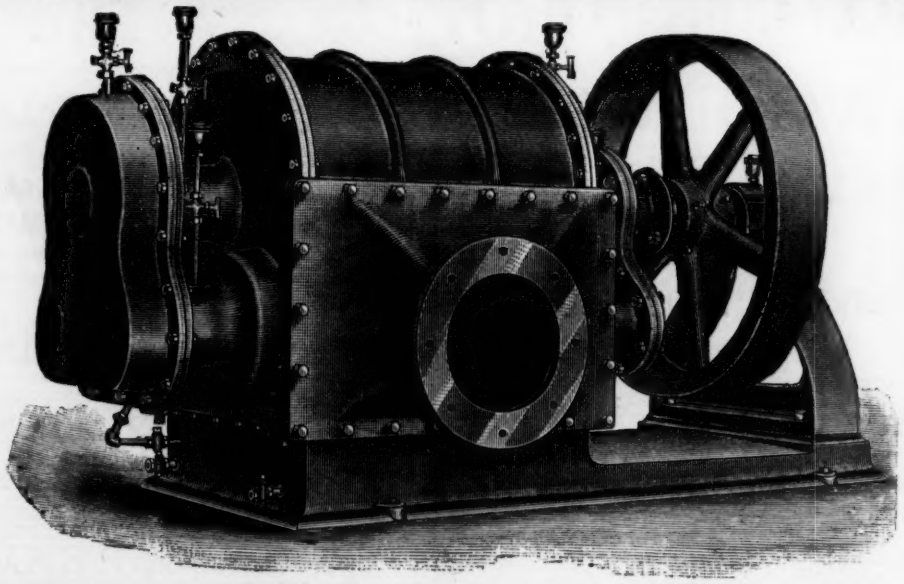

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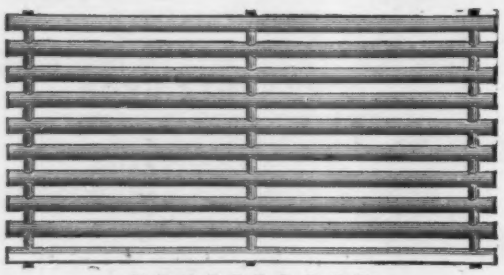

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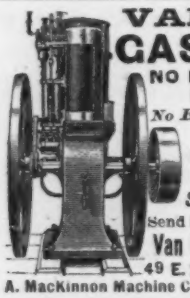

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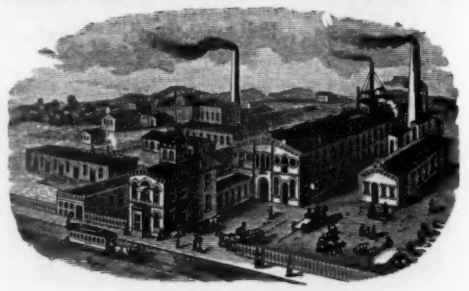

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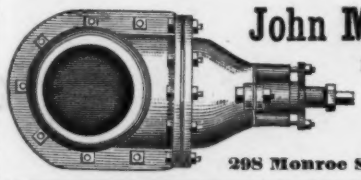

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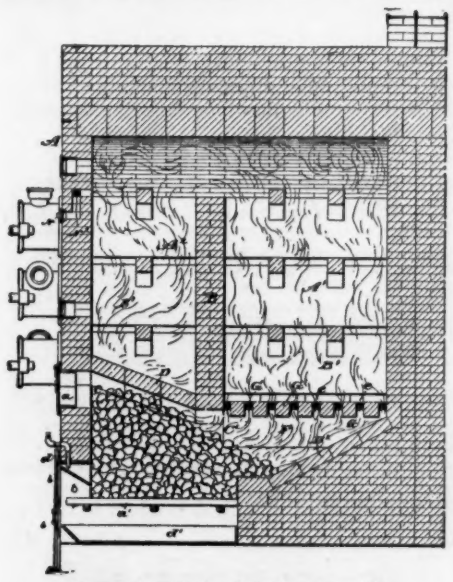

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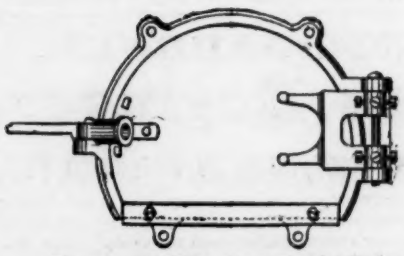

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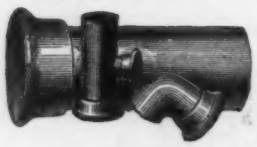

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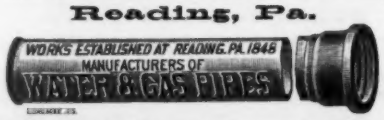

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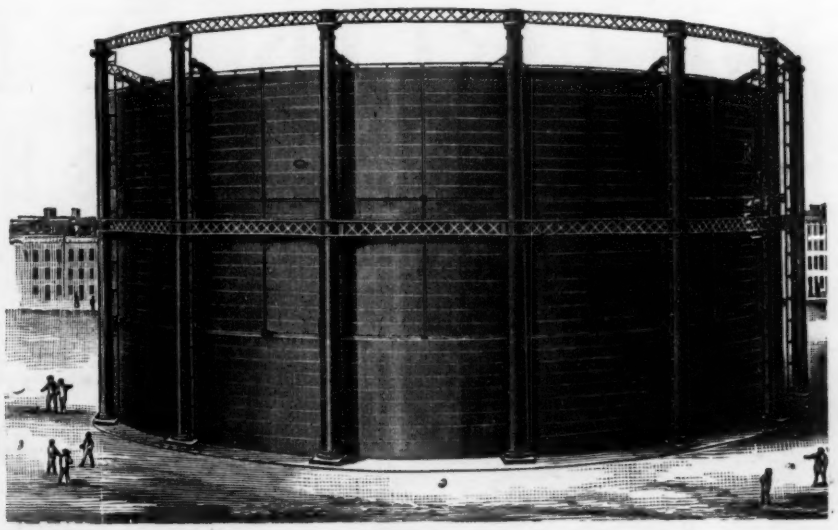

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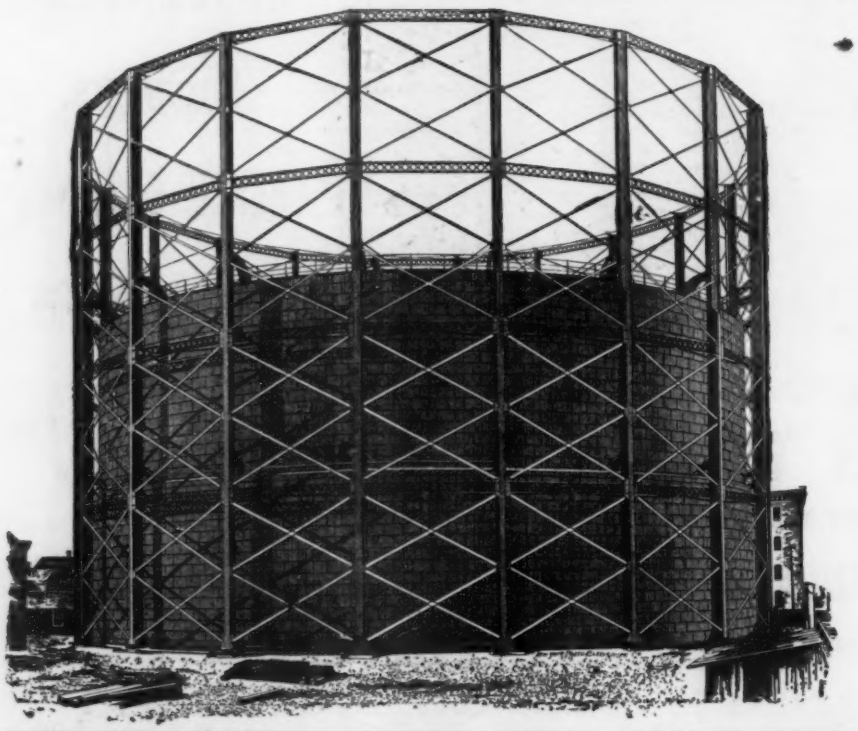

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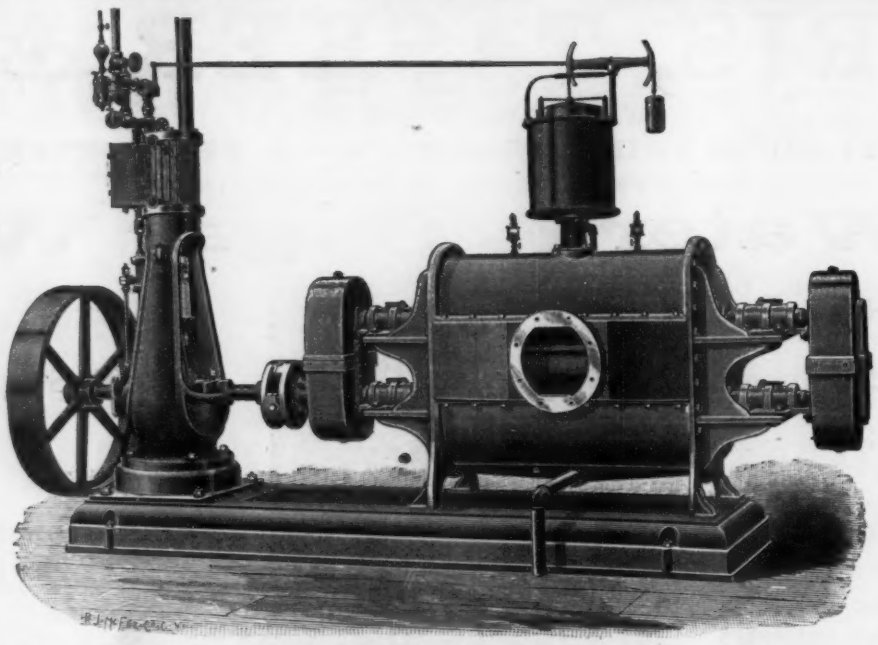

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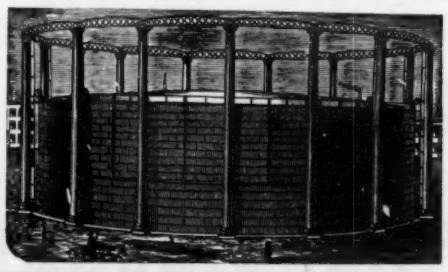

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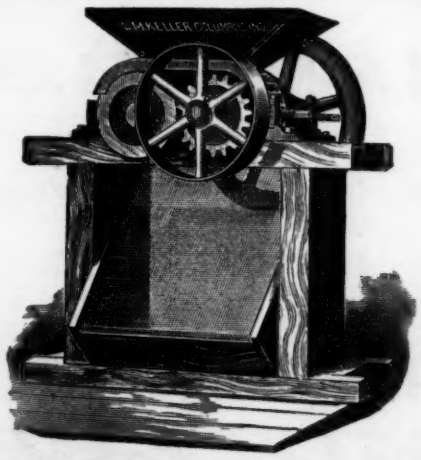

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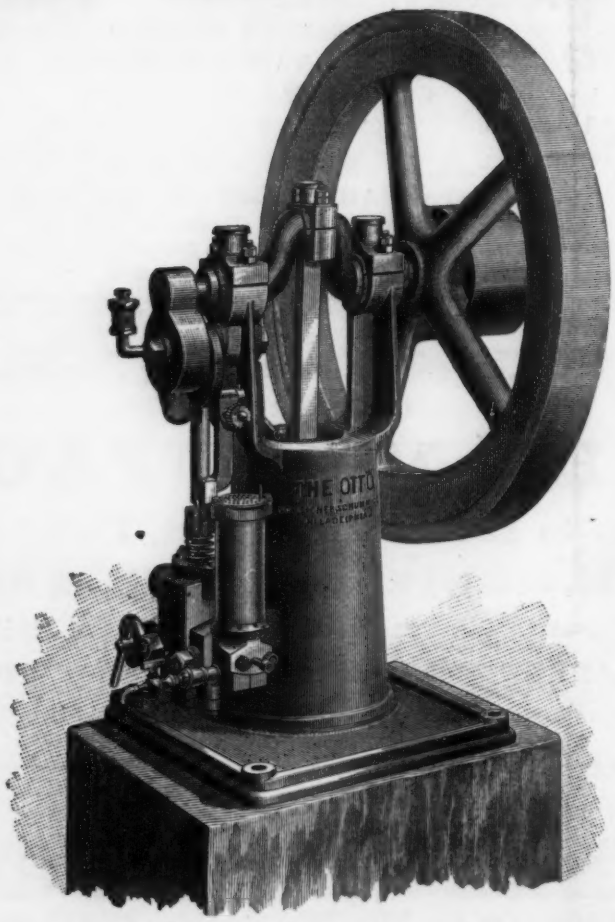

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